THE ENGINEERING AND MINING JOURNAL.

RICHARD P. ROTHWELL, C. E., M. E.
ROSSITER W. RAYMOND, Ph. D. } Editors.

NOTE.—Communications relative to the editorial management should be addressed to Mr. ROTHWELL. The articles written by Mr. Raymond will be signed with a star.

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ERRATA.

IN the report of the Conversazione of the Institute of Mining Engineers given in our last issue, page 24, Dr. HUNT was inadvertantly made to say, that the Cromwell ore deposit occurs in the mesozoic red sandstone, instead of the primal slates ; and for Cromwell reads Cornwall ; also in speaking of the brown ores, they should have been placed in the Silurian rocks.

SAUCE FOR THE GANDER.

THE *Bulletin du Comité des Forges de France*, commenting upon the anger of the Welsh iron manufacturers over a recent purchase made by the English Government in Belgium, of iron says :

"The discontent of the ironmasters is the greater, because the present demand is small in proportion to their means of production. They talk of nothing less than of carrying the question into the House of Commons. To us it appears at least singular that the English, who make themselves the apostles of free trade, could find fault with the contract entered into by their government. We knew already that in Germany the bids of foreign manufacturers were readily refused ; but we did not expect to see the English entering upon that path. So far as we know, not a single occurrence of the kind has ever taken place in France."

The *Bulletin* may rest assured that human nature is much the same everywhere, and stronger than any sense of political consistency. The prospect of losing the market by free competition will make a good many political economists, who happen also to be manufacturers, modify their creed of free trade. And if the same phenomenon has not appeared at any time in France (a proposition which can be true, we think, for recent periods only) it is because the same strain has not been put upon French ironmasters, and not because they are any more likely to rise above their own immediate interests in obedience to a doctrine of political economy. We fancy, however, that the ironmasters of Wales would get little satisfaction from Parliament, if they should bring their grievance before that body. The principle that the government must buy iron dear, because it is domestic, or refuse to buy it cheap, if it is foreign, would violate too clearly the British sense of equity and honesty to be acceptable to the British House of Commons. Protection by tariff is a different matter. If the British iron trade needs that, let it say so, and get, if it can, what it needs. That would be a regulation affecting equally all purchasers. But, while individuals may buy freely in any market, the attempt to restrict the government is mere plunder of the Treasury. It is like demanding extra wages for the laborers on municipal public works, or clamoring for unnecessary or extravagant public works, as a means of conciliating "hard-handed voters." Things of this kind do sometimes occur in wicked America ; but in enlightened Britain—well, at least they can't be carried openly through Parliament : unless, indeed, "human nature" should too strongly revolt against the basting of the gander with that mixture which has always been considered an excellent sauce for the goose. *

OBITUARY—HOWARD PAINTER.

THE death at San Francisco, on the 15th of May last, of HOWARD PAINTER, M. E., has deprived the profession of one of its most promising young members. Only twenty-six years of age at the time of his death, Mr. PAINTER had already made himself favorably known in technical literature ; and his friends had good reason to expect that a career so auspiciously begun, and based upon so thorough a preliminary preparation, would develop, under the favorable conditions of active practice, into great usefulness and fame. We had not the pleasure of a personal acquaintance with him ; and hence we speak, not our own knowledge, but the general testimony of those who were more intimately associated with him, when we give him credit for varied accomplishments, unusual intellectual powers, and sterling worth, as well as peculiar attractiveness, of character. His professional activity was brief. After a five years' course at Freiberg, at the close of which he passed successfully the "State examination"—being, it is said, the only American student who ever submitted himself to this test—he was appointed one of the United States Commissioners to the Vienna Exposition ; and in this capacity he prepared the report on the metallurgy of lead, silver, copper, and zinc, as illustrated at that exposition. This has been recently published by order of Congress, as one of the series of official Vienna reports. We have not yet had an opportunity to examine it ; but we have heard it spoken of in high terms.

After his return from Europe, Mr. PAINTER was occupied for some time with professional labors in Colorado and Nevada ; and was on his way, in the discharge of similar duties, to Southern California and Arizona, when his brief career was terminated by an attack of mountain fever, which rapidly developed into pneumonia.

He had been, in 1874, elected to membership in the American Institute of Mining Engineers ; and the transactions of that society would doubtless have been enriched with some points of his intelligent study and growing experience, but for the sad, untimely end which has overtaken a beginning so auspicious and hopes and prophecies so fair. The circle which chiefly mourns the loss of the son and friend, has our heartfelt sympathy, while we speak also for the wider circle, which laments the loss of all that the trained and zealous professional brother might have achieved for industry and science. *

NEW PUBLICATIONS.

PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY, *from January to June*, 1876. Philadelphia.

This volume contains several papers of interest to engineers and chemists. Foremost among them we must mention Mr. CHARLES ALLEN'S *Contributions to the Physical Geography of the United States*, presented, with some interesting introductory statements, by Prof. J. P. LESLEY. Mr. ALLEN is the assistant in charge of the collection of railroad and other levels for the Second Geological Survey of Pennsylvania ; and this paper presents the results of his labors, in the form of hypsometric tables reduced from the numerous railway and canal surveys of the State. Information of this kind is extremely valuable ; and yet, for want of accurate record and careful preservation, it is often lost to science. As Prof. LESLEY points out, correct base-line levels are necessary to good geological field-work. In our most important department of dynamic geology, namely, the determination of the movements still taking place in the earth's crust, and the secular changes in continental levels, such data are indispensable ; and they should be made complete, both in accuracy and in extension over large areas and long periods. Much remains to be done, before safe generalization can proceed from the observations collected. In any given instance, it is probable that an apparent change of level, indicated by comparison of an ancient with a recent determination, may be due to instrumental differences or errors. Yet a large amount of cumulative evidence of this kind would, even in the present uncertainty and meagerness of the records, carry almost conclusive weight. At all events, the beginnings made for Pennsylvania by Mr. ALLEN, together with the valuable hypsometric tables published by the State Geologists of Ohio and North Carolina, and the careful work of various United States exploring parties in the West, constitute a substantial advance towards the materials for a sure induction.

We note also in this volume a description by Mr. J. BLODGET BRITTON of his improved mounted burettes for volumetric analysis. The delicate adjustment and graduation, and the convenient arrangement of these tubes recommend them for quick and close determinations.

Mr. JOHN E. WOOTEN, of Reading, Pa., contributes a paper on the successful use of anthracite waste in a locomotive, by means of his apparatus for pressing the coal dust in a thin layer upon a perforated plate, over a closed ash-pit, into which a steam-jet is conducted for the maintenance of a draft. This method has been in successful operation for some time upon the track and in the works of the Reading Railroad. We forbear to discuss Mr. WOOTEN'S paper, because we shall shortly publish the remarkably clear and forcible description of the same invention, contained in Mr. GOWEN'S address of welcome to the Institute of Mining Engineers, at Philadelphia.

The paper of Mr. HENRY HARTSHORNE on *Some Disputed Points in Physiological Optics*, though outside the proper sphere of this Journal, is worthy of mention at our hands, as a very lucid and interesting discussion. Mr. HARTSHORNE appears to have experimentally refuted, in part at least, the accepted doctrine of visual fatigue, as the explanation of certain phenomena of complimentary colors, etc. The theory which he suggests in its place is plausible ; but, perhaps, it will prove on closer examination and test, equally inadequate.

Very attractive, though brief, is the note by Prof. FRAZER on DELESSE'S great work on the lithology of the sea-bottom, which concludes with a well-deserved expression of the gratitude due to the distinguished author from American geologists for the great contribution he has made to our knowledge of our own coasts. It is indeed to be hoped, as Prof. LESLEY remarked, that either the whole of this admirable work may be translated and republished, or at least the one map of the American Continent and its inclosing water-beds may be reproduced and made accessible to American students.

The volume closes with an elaborate, but rather confused, paper by Mr. ELI K. PRICE, on *The Glacial Epochs*. Mr. PRICE combats the theory of the Continental or circum-polar ice-sheets, and brings against it many of the well-known objections. Probably few would deny the difficulties of the theory, or the extravagances of some of its advocates. But it is not easy to frame a hypothesis in its place. [Mr. PRICE introduces a number of theological sentiments, appar-

ently intimating that the glacial theory is impious, while his own view is pious —a style of argument which sorely tries our patience.

RESOURCES OF WEST VIRGINIA, by M. F. MAURY, *Fellow of the Geological Society of London, Member of the American Institute of Mining Engineers, Associate of the Royal School of Mines, England, and* WILLIAM M. FONTAINE, A. M., *Professor of Natural History, etc., at the University of West Virginia. Prepared under the State Board of Centennial Managers.* Wheeling, 1876.

The special exhibit of West Virginia at the Centennial Exposition has attracted much attention and admiration. Its influence in attracting both immigration and capital to that favored region will be powerfully reinforced by this handsome volume of 430 octavo pages, in which the topography, climatology, and agricultural geology, farm products, cattle and grasses, sheep and wool, forest trees, shrubs, and medicinal plants, timber, coal, iron, salt and petroleum, miscellaneous minerals and ores, mineral waters, facilities of transportation and educational interests of the State are successfully set forth. We have no doubt that this publication will be as valuable to those who are already citizens of West Virginia as to those whom it may induce to become so. It abounds in suggestions based on experience or science, by the adoption of which many a profitable industry, now only local or scarcely thought of, might be extended over new areas and made permanently at home as part of the resources of a rapidly growing community. ✲

AMERICAN INSTITUTE OF MINING ENGINEERS.

Annual Meeting Held in Philadelphia, June, 1876.

OFFICIAL REPORT.

THE opening session of the annual meeting was held in the hall of the Franklin Institute on Tuesday evening, June 20, President HOLLEY in the chair.

The President introduced Mr. FRANKLIN B. GOWEN who, in an introductory address, welcomed the Institute to Philadelphia. (This address will be published in a subsequent number of this JOURNAL.)

At the conclusion of Mr. GOWEN's address, President HOLLEY said :—

GENTLEMEN :—I am sure that I express the feeling of the members of the Institute, and also the sentiments of our guests, when I return to President GOWEN our hearty thanks for his beautiful and eloquent words of welcome and encouragement, information and instruction. There are so many suggestive thoughts in his remarks, especially in regard to the utilization of waste coal, that I can hardly refrain from starting a discussion on that subject, and would do so if time permitted. But when time does permit I am sure that subject will be very fully and thoroughly discussed by the members of this Institute, as being one of the most important that could be brought before them, the pleasure and satisfaction in the discussion being enhanced by the careful and perspicuous way in which President GOWEN has introduced the subject. The courtesies of President GOWEN to the Institute in times past, and those which the programme leads us to believe that we shall experience during the present week and the week which is to come, are so conspicuous, that I might properly, and would gladly, devote the remainder of our time to-night in returning our acknowledgments to him. But, gentlemen, I must leave both of these subjects for another and most pleasant duty I have to perform, and that is, to announce to you, officially, the election this Centennial year, of the Honorable ABRAM S. HEWITT as President of the Institute. Gentlemen, the election of Mr. HEWITT was one of those matter-of-course occurrences, which spring out of a spontaneous feeling of fitness and propriety among the members of the Institute. A large experience at home has enabled him to deal with practical questions connected with the iron manufacture, and given him a great intimacy with those commercial and political considerations which affect metallurgy both as a profession and as a trade. His professional education and commercial qualifications, his traditions of leadership in all the enterprises in which he has engaged—all these things have had their influence in this election, and while Mr. HEWITT, in consequence, takes upon himself an additional honor, he confers an additional honor upon the Institute.

Gentlemen, Mr. HEWITT, the President-elect, will now address you.

(Mr. HEWITT's address was published in this JOURNAL of June 24.)

On the adjournment of the session, Mr. HEWITT received the members of the Institute at the Centennial headquarters, 1100 Girard Street.

SECOND SESSION, held at the Judge's Hall, Centennial Grounds, Wednesday morning, June 21, at 10 o'clock.

After announcements in reference to excursions by Mr. E. B. COXE, President HOLLEY introduced Mr. I. LOWTHIAN BELL, M. P., F. R S., who read a paper on the Hot Blast, with an Explanation of its Mode of Action in Iron Furnaces of Different Capacities. (This paper was published in this JOURNAL of July 1.) At the conclusion of Mr. BELL's paper, Mr. PECHIN said :

I am quite sure that I am speaking for every member of the Institute in expressing to our distinguished guest our satisfaction in having him here to-day to read this paper, and our hearty thanks to him for his extremely interesting and valuable contribution.

Our place of meeting has been an unfortunate one, owing to the confusions and interruptions. While we may regret that there has not been a better opportunity of listening to Mr. BELL, we can congratulate ourselves that his paper will very shortly be in print, where we can all read it. This paper is now open to discussion. We should be very glad indeed to hear an expression of opinion on the part of any gentleman connected with the Institute of Mining Engineers, or the Society of Civil Engineers, or our foreign guests.

Remarks were made by Messrs. COXE, ALEXANDER, EGLESTON, and others, with reference to the undesirability of commencing the discussion of Mr. BELL's paper, owing to the noises and interruptions to which the meeting was subjected. The meeting was then adjourned by the President. On Wednesday evening, a dinner was given by the Institute to its foreign guests at Belmont Mansion, Fairmount Park. Thursday was spent by the Institute and invited guests on an excursion on the Delaware River, a steamer being placed at their disposal by the courtesy of the Philadelphia and Reading Railroad.

On Friday, three sessions were held at the Hall of the Franklin Institute, when the following papers were read and discussed :

MORNING SESSION.

The Lead District of South-Eastern Missouri, by Prof. G. C. BROADHEAD, of Pleasant Hill, Mo.

The Nomenclature of Iron, by Prof. H. WEDDING, of Berlin.

Some Discoveries in Lake Superior Iron Ores, by Dr. THOMAS EGLESTON, of New York.

Black-band Ores of Ohio, by Prof. J. S. NEWBERRY, of New York.

History of the Bessemer Manufacture in the United States, by R. W. HUNT, of Troy, N. Y.

Mr. E. B. COXE called the attention of those present, to the exhibition of a working model of a modern coal breaker at 539 Chestnut Street, which gave a capital idea of the manner of hoisting, dumping, breaking, screening, and loading of anthracite coal. The agent of the model has given an invitation to the members of the Institute to visit the exhibition, and Mr. COXE said it was a good opportunity for those unfamiliar with anthracite mining, to see how coal was destroyed in Pennsylvania.

Mr. OLIVER EVANS WOOD read to the Institute some very interesting original documents with reference to the early use by OLIVER EVANS, of anthracite coal in the melting of iron. (These documents, by the kindness of Mr. WOOD, will be subsequently published in this JOURNAL.)

In the course of the discussion of Dr. WEDDING's paper, Prof. EGLESTON offered a resolution, that an International Committee, of which Mr. HOLLEY shall be Chairman, be appointed to determine and limit the use of terms used in the nomenclature of iron and steel. Prof. EGLESTON subsequently modified the resolutions to read, of which Mr. HOLLEY shall be one of the members. It was then carried.

AFTERNOON SESSION.

The Endurance of Iron Rails, by W. E. C. COXE, of Reading, Pa.

The discussion of Mr. BELL's paper on the Hot Blast, read at the Wednesday morning session.

Geological Explorations with the Diamond Drill, by L. A. RILEY, of Ashland, Pa.

Composition of Flue-dust, by J. BLODGET BRITTON, of Philadelphia.

Coal Fields of Japan, by H. S. MUNROE, of Brooklyn, N. Y.

EVENING SESSION.

Mr. PECHIN in the chair.

The Chaudron Process of Sinking and Tubing Shafts, by JULIEN DEBY, of Brussels, Belgium.

Spelter Manufacture, by F. L. CLERC, of Bethlehem, Pa.

Explosion of Fire Damp at the Midlothian Colliery, Va., by OSWALD J. HEINRICH, of Midlothian.

On Saturday, an excursion was made via the Philadelphia and Reading, East Pennsylvania and Lehigh Valley Railroads, to Phœnixville and Bethlehem.

On Monday, three sessions were held at the Franklin Institute.

MORNING SESSION.

Mr. PECHIN in the chair.

The following annual report of the Council was read and adopted :

In accordance with the requirements of the rules, the Council has to report to the Institute, that during the past year, three meetings have been held, to wit, in Dover, Cleveland, and Washington. These meetings have been largely attended, the scientific and technical papers read have numbered 70, and have been of great value, and the mines and works visited, of great professional interest.

168 new members have been elected, and 43 associates, also 3 foreign members—a total accession of 214. The membership of the Institute now comprises :

Honorary members	4
Life members	4
Foreign members	41
Members and associates	563
Total	612

The Institute has lost by death six home, and two foreign members—men whom the profession could ill afford to lose :

AUGUSTUS STEITZ, of St. Louis.	J. G. WITHERBEE, Port Henry, N. Y.
HOWARD PAINTER, West Chester, Penn.	H. F. Q. D'ALIGNY, New York City.
CHAS. VON LIEBENAU, Silver City, Idaho.	ED. BLACKWELL, London.
A. J. BROWN, Treasure City, Nevada.	J. B. A. LORSONT, London.

The third volume of transactions has been issued and distributed to members, and to scientific societies and libraries at home and abroad. A valuable library is accumulating through the exchanges of the transactions, with those of other scientific and technical societies. The report of the Treasurer shows the receipts for the year to have been $6,493.98, and a balance on hand of $1,428.24. The Council congratulates the Institute on the success of the work of the Centennial Committee, in providing headquarters for the Institute in Philadelphia, and for the admirable arrangements it has made for the convenience and entertainment both of the members and foreign guests.

Mr. DRINKER, the acting secretary, then read the list of names which had been formerly proposed as members, foreign members, and associates, and had been approved by the Council.

It was moved and carried that the President cast a ballot for the Institute in favor of the election of the gentlemen named if there were no objection made. The President then cast the ballot for the Institute.

Prof. FRAZER said : I intend to give notice at proper time, of a motion making a change in the rule of the Institute in regard to election of members. There is no doubt that most of the gentlemen named are unobjectionable, but the principle is bad to allow a large number to be taken in, in this way. We know the Council are composed of competent men, but the system is too much like oligarchical government, to suit my taste. I would propose that a list be made out of the candidates for membership, and that this be forwarded by the Secretary of the Institute to each of the members. An opportunity will thus be given for a more general and satisfactory vote.

Prof. FRAZER offered the following Resolution, which was unanimously adopted :

Resolved That the sincere thanks of the American Institute of Mining Engineers be tendered to the Philadelphia and Reading Railroad Company for the generous and intelligent assistance offered to it and its foreign guests during the present session, and to Mr. FRANKLIN B. GOWEN, the President of that company, through whom these facilities were extended.

In commenting upon the resolution, Prof. FRAZER said that only one who, like himself, had worked upon one of the committees could appreciate the munificence and kindness of Mr. GOWEN, and the small amount which could have been done by the Institute, without the assistance of the Reading Railroad Company.

The following resolutions was then offered and unanimously passed :

Resolved, That the thanks of the Institute of Mining Engineers are hereby extended to the Franklin Institute for the use of their Hall and Building ; to the Society of Civil Engineers, Academy of Natural Sciences and other societies for courtesies extended, and to the Local Committee for their efficient and admirable services in securing the convenience and pleasure of the members and their guests.

Prof. FRAZER said that he withdrew his notice of amendment to the rules, a he had learned that the subject had already been considered by others, and that they had taken steps looking to that end.

Mr. J. B. BRITTON spoke of the desirability of issuing certificates of membership in the Institute and wished the subject referred to a committee.

The CHAIRMAN remarked that the subject had already received earnest consideration in the Council, and that the feeling was rather against issuing certificates.

After some discussion, whether the subject should be referred to the Council or to a Committee, Mr. BRITTON withdrew his motion.

Mr. J. B. PEARSE subsequently renewed the motion, which was carried, that the council be hereby requested to consider and report on the propriety of issuing certificates of membership.

Mr. J. S. ALEXANDER, in the absence of the Chairman of the Centennial Committee of the Institute, spoke of the finances of the Committee. The original programme contemplated the raising of $5,000. The sum of $4,200, has been subscribed which was insufficient to cover all the expenses of the Committee. He appealed to those who had not already subscribed to assist the Committee as liberally as they could.

The papers read and discussed at this session were :

The Iron Manufacture in the United States, by J. B. PEARSE of Philadelphia.

A Study of the Specular and Magnetic Iron Ores of the New Red Sandstone in York County, Pa., by Professor PERSIFOR FRAZER, Jr., of Philadelphia.

The Reconstruction of a Furnace Crucible while in Blast, by J. H. BRAMWELL of Quinnimont, West Va.

Roasting of Sulphurous Iron Ores in New Jersey, by C. H. VANNIER, of Succasunna, N. J.

Water in Coals, by J. BLODGET BRITTON of Philadelphia.

AFTERNOON SESSION.

President HOLLEY in the chair.

A Paper on the Minerals of South Western Virginia was read by Mr. C. R. BOYD of Wytheville, Va.

Mr. J. S. ALEXANDER of Philadelphia exhibited some specimens from a newly-discovered deposit of argentiferous and auriferous copper ore in Llano County, Texas.

This ore occurs in an East and West fissure vein, between well defined wall rocks, dipping at an angle of 45° towards the South. At the top the lead is seven feet, and at the bottom of the present exploring shaft (35 feet) it widens to ten feet. The ore occurs in veins and spurs diffused through white quartz, and increases in quantity with every foot of depth, but whether the present well-defined lode continues to any great distance, vertically or longitudinally, the limited exploration of course cannot determine. The richer parts of the lead is the Peacock ore of the miner, the Erubesite or Carnite of the mineralogist, and is reported, but by what analyst, I am uninformed, to contain 35 per cent. of metallic copper and one hundred and twenty dollars in gold and silver. This new mineral district possesses an additional interest from the fact of it being so far east of the meridian of heretofore wrought lodes containing the precious metals. The specimens before you are from a depth of twenty-four feet, and are not so rich as the ore found at thirty-five feet, of which, unfortunately, I have been as yet unable to receive specimens.

A profile drawing of the Sutro tunnel, sent to the Centennial Rooms by Mr. SUTRO, through one of the members of the Institute, Mr. JAMES D. HAGUE, of San Francisco, was then shown by Mr. ALEXANDER, who, in a brief sketch of the object and progress of that great engineering work, stated that up to June 1st, of the present year, 13,338 feet of the entire distance, about 20,000 feet, had been successfully accomplished ; and that although many of the great Comstock mines were already approaching and pushing below the level of the tunnel (nearly 2,000 feet at the Comstock Lode) which will preclude the possibility of a thorough drainage of the lode without pumping, the completion of the tunnel will, nevertheless, greatly facilitate the exhaustion of the water by lessening the lift 2,000 feet, and furnish, besides, a new and economical outlet for the ore. Mr. H. S. DRINKER, of Philadelphia, being called upon by Mr. ALEXANDER, as the possessor of much detailed information, then gave an interesting account of the early history of the enterprise, together with statistics of progress.

Two papers by Prof. E. T. COX of Indianapolis were then read by title in the absence of the author : Porcelain Clay in Indiana and Physical Changes in Coal under Influences of the Atmospheric and Moderate Temperature.

EVENING SESSION.

President HOLLEY in the Chair.

The papers read at this session were :

On the Manufacture of Forged Car Wheels, by Prof. ADOLPH HENRY, of St. Etienne, France.

On the Metallic Deposits of Japan, by A. S. MUNROE, of Brooklyn, N. Y.

A Study of Igneous Rocks, by Prof. PERSIFER FRAZER, Jr., of Philadelphia, and the following papers by title :

Some Points in the Treatment of Lead Ores in Missouri, by Prof. C. P. WILLIAMS, of Rolla, Mo.

Palæozoic Strata in Huntingdon Co., Pa., by C. A. ASHBURNER of Philadelphia.

Defection of Girders, by W. S. AYRES, of Trenton, N. J.

Composition of Silver-Gray Iron, by EDWARD HART, of Easton, Pa.

Some Things that Affect the Production of Carbonic Oxide in the Blast Furnace, by CHARLES HIMROD, of Youngstown, Ohio.

Definition of Steel, by WM. METCALF, of Pittsburg, Pa.

Hematite Ore Mines East of the Hudson River, by J. F. LEWIS, of Amenia, N. Y.

Theories of the Blast Furnace, by Prof. T. EGLESTON, of New York.

The Report of the Committee on Railway Resistances was received and ordered to be printed.

Mr. PECHIN then offered the following resolution, which was adopted unanimously :

Resolved, That the best thanks of the American Institute of Mining Engineers are hereby tendered to Mr. A. L. HOLLEY, the retiring President of the Institute, for his most capable, energetic, and successful administration of the duties of his office during the past year.

After a brief reply by Mr. HOLLEY, the Institute adjourned.

On Tuesday and Wednesday, June 27th and 28th, the members of the Institute and invited guests visited the Schuylkill coal regions of Pennsylvania, transportation and entertainment being munificently provided by Mr. FRANKLIN B. GOWEN, President of the Philadelphia and Reading Railroad.

ABSTRACTS OF LECTURES ON MINING.—No. 11.

By Prof. W. W. Smyth, M.A., F.R.S., Royal School of Mines, London.

(From the London "Mining Journal.")

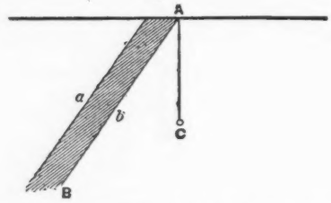
IN the last lecture we saw that there were certain conditions which was necessary to keep in mind in dealing with stratified deposits, in order to prevent unnecessary disappointment. One of them, you will remember, was the fact that in following up a particular bed or seam it is frequently found to change more or less in character. Among the stratified minerals I need only remind you of the whole of the fossil fuels, including the coal proper and lignites, in some cases presenting great uniformity over enormous areas. Then, again, a large number of building stones and slates scattered over a large portion of this and other countries. The occurrence of salt, too, sometimes extremely irregular, in nodules and scattered masses is—as, for example, in our own country in Cheshire—so regularly stratified that you may depend upon the quality and thickness of the bed throughout the greater part of the formation in which they are placed. About 27 or 28 years ago a commencement was made in this country to work stratified iron ores, though in this we were probably anticipated long ago by the Romans. The recent workings commenced at Middlesborough, in the north-east of Yorkshire, first from ore obtained on the sea shore, and afterwards from the regularly stratified deposits among the rocks called lias. A large iron-working district has grown up in that part, and from two to three million tons are now annually raised. Another series of stratified iron ores are those of Northamptonshire and other of the Midland Counties, which have come into great importance since the time of the Exhibition of 1851 : they belong to the Oolite formation. These stratified deposits attain a thickness of from 3 ft. to 4 ft. on an average, sometimes as much as 16 ft. ; while similar deposits in Michigan, in the United States, are said to have a thickness as great as, and sometimes exceeding, 60 ft., with a great amount of parallelism and regularity. We are sometimes told of stratified deposits of lead and copper ores, but against these statements we must be on our guard ; for there are certain metalliferous deposits obviously connected with veins, others which appear to have no connection, but have close approximation to stratified conditions, while from these we pass to a class which we may consider as truly stratified. As an example of the latter, I may mention that curious district of central Germany which runs from Mansfeld, in what used to be called Prussian Saxony, to the foot of the Harz Mountains, where there is largely developed a cupriferous slate—Kupferschiefer. This is a marl slate, generally not more than from 6 to 14 in. thick, with copper pyrites disseminated through it, enriched here and there with strings of bornite : generally there is not more than from 3 to 4 per cent. of copper, but there is also a small proportion of silver. The working of this district has been carried on under the State with a remarkable amount of practical knowledge and scientific attention for the last 200 years, supporting a large population, and giving a tolerable profit. Then, also among the stratified deposits we have the lead ores of the Bunter Sandstein between Aix-la-Chapelle and Cologne, where you have many fathoms thickness of white sandstone, with lead ore—chiefly galena—scattered through it ; there is only about 3 per cent. of ore, but many thousands of tons of this material are turned over, and altogether a large product is obtained. We should, however, in most cases—and I am not sure whether it is not so in these particular cases—find that the minerals have been subsequently introduced into the rock in which they are found ; and this would bring them into close connection with those we have next to examine—veins or lodes.

From veins or lodes a large proportion of the metallic minerals are raised. "Vein" is a general name, "lode" is the term almost invariably used in the western districts ; in the central and northern parts of England the term "rake vein" is applied to those which have a considerable inclination, as they generally have in those parts. The terms corresponding to vein are—*filon* (French), *filone* (Italian), *gang* (German, with plural *gänge*). You very often see it stated that the veins have a considerable resemblance to the veins of the human body, or to the branches and twigs of a tree, but there is, in fact, no such resemblance. And some people, with such ideas in their heads, have been known to spend a deal of money in digging down and following the small twigs or veins, under the impression that in time they would come down to the branches, and ultimately, perhaps, to the trunk. Lodes are examples of what are most capricious in nature ; they are spaces between two walls, more or less parallel to each other, but sometimes deviating from this excessively, running with more or less regularity as to their line of dissection and line of dip into the earth, and filled often with a great variety of matters, some of which may be useful to the miners, others useless. Some of these matters, therefore, will be the objects of search, and will be present in greater or less quantity, with no reference to the size of the vein. At the very outset it is important to become acquainted with what we may have to meet in the way of irregularities, and to inquire how far these irregularities justify us in giving an adverse judgment as to the working of the veins. In the first place, we find them intersecting rocks of various ages, so there can be no doubt the veins were introduced subsequently to the formation of the rocks themselves ; and where, as in Cornwall, frequently, we have a vein cutting right across the junction of killas (slate) and granite, it has evidently been formed subsequently to the formation and consolidation of both killas and granite. Very generally in literature the celebrated WERNER, of Freiberg, one of the masters of geology, has been credited with being the first to put forth the theory of veins being originally fissures in the rocks, but I must claim this honor for our countryman, Dr. PRYCE, of Redruth, who has written a very excellent, though now somewhat antiquated, treatise on these matters, called "Mineralogia Cornubiensis." We have often proof of the correctness of the idea, as, for example, cavities still remaining in parts, frequently lined with to crystallized or stalactitic formations. The terms already given apply chiefly to veins of considerable size ; when they come down to the size of an arm or a finger they are called "branches," especially if they be of tolerably good ore : still smaller ones are called in Derbyshire "scrins," and such strings are of great importance in the case of lead ore, or tin ore. The presence of a number of these small strings may make it worth while to work a considerable area of the rock. Such work is called by the Germans "Stockwerke." We have examples of this in our granites and clay-slates. Of course, we shall have to deal with the dip and extension of the lodes. The dip is called the "underlie" (or "underlay" of the miners,) or "hade."

The miners prefer to measure the angle of inclination from the perpendicular, and not from the horizontal, as geologists and engineers do. Thus (Fig. 4) the plumb line, A C, is seen to be under the lode, A B, by a number of degrees measured by the angle B A C; the lode, A B, is, therefore, said to underlie by so many degrees. In the large tract of mining ground in the North of England which extends from Skipton, in Yorkshire, to Scotland—lead mining

in the carboniferous limestone—a large number of the veins are nearly perpendicular. In these you are apt to meet with a slide, or slip, which carries the vein along horizontally for a short distance—it may be several feet or fathoms—and then the vein passes down again. This is frequently found to be associated with a change in the rock in which the lode lies. We must be prepared to allow a margin for interruptions of this kind in dealing with districts in which such circumstances are liable to occur. In all districts there is a variability more or less, but in some more than others. If you have a lode which in some places is almost vertical, in others less so, it will be found to be a rule almost universal that the more perpendicular portions will be most productive of ore, and that the less inclined parts will be poorer. And this variation in the amount of underlie as the lodes are followed down into the earth is very common, a lode sometimes coming to lie in one part in just the opposite direction to that which it has in another. The boundary planes of the lode are generally called its walls, the lower one (Fig. 4. *b*) being called the foot wall, the upper one (Fig. 4, *a*) the hanging wall; in the same way the Germans use the terms "Liegende" and "Hangende." In the North of England, since the

Fig. 4.



veins run in an east and west direction, the walls are called cheeks, one being the north cheek, the other (on the south) being the sun cheek. The thickness of the vein is the distance between the walls, and these walls may be in some cases defined and well marked, in others it will be hard to say where the vein ends and the rock begins; and the miners are sometimes at a loss to say whether they are in the vein or not. I shall have more to say on this subject hereafter, I will only now say that generally a well-defined wall is much approved of by the miner. It happens that in some cases on one or both walls a thin band of clay—flookan—lies between the vein and the rock, which serves, in the first place, to define the boundary of the vein; and, secondly, to facilitate the removal of the veinstuff from the boundary wall; and sometimes the presence of this may determine the practicability of working the lode. In some lead veins of the county Wicklow, in Ireland, you will find a well-defined lying wall, but the hanging wall so confused and intermixed that you cannot distinguish it from the "country," or surrounding rocks. The greater part of the lodes have a dip lying between 90° and 45° and in certain districts it is sometimes observable that there is more or less regularity in the amount; thus in the district of Truro and St. Agnes, in Cornwall, a great many of the veins dip at such low angles that miners from other districts not accustomed to such a dip would condemn them unhesitatingly. In some of the St. Agnes lodes you may actually walk along the foot wall, so low is the angle of dip—similarly in Saxony they have their "schwebende Gänge"—and in one case, near Truro for a descent in vertical depth of 25 fathoms you have to go 125 fathoms down the lode.

With regard to the thickness of veins which can be worked we have great variation. In Derbyshire veins of 1, 2, and 3 inches are worked. It depends to a great extent on the nature of the rock with which they are associated; as, for instance, whether it will powder well under the stamps. We may say the average thickness, width, or "power," of the lode will be between 1 ft. and 6 ft.; this is the case in districts so well characterized as the districts of the North of England, Wales, Cornwall, and Devon. In some of the mines of the Isle of Man you have veins of much greater thickness—*e.g.* in the Laxey Mine not unfrequently 12 to 18 ft.; Foxdale Mine 36ft. (with 30 ft of workable rock), and in the Devon Great Consols it has sometimes reached 40 ft. At Schemnitz a lode has reached as much as 120 ft. and in Mexico 140 ft.; but the most remarkable case is that of the recently-discovered Comstock lode, in Nevada, where some of the best (silver) producing parts have reached 200 to 300 ft. in breadth from wall to wall. Not only do the lodes vary in direction and dip, but as you follow them you find them extremely capricious as regards form. I have seen lodes of good size rapidly become "nipped up" so that nothing but a small string was left; for example, in the Devon Great Consols a vein having a total width of 50 ft. has in a few fathoms become pinched up to a width of only 6 in., and that nothing but quartz. Hence the folly—I might almost say wickedness—of the statements put into prospectuses, etc., formed on the piercing of a vein at one or two points only. With regard to the structure of the lode, in a great majority of cases we see no particular structure whatever, as in these two specimens—one from a vein of ironstone, the other a piece of tinstone, in both cases almost pure. In other cases you may have a very homogeneous mass of quartz, having scattered through it particles of cassiterite (tinstone). There is a hard gray variety of quartz, called by the miners capel, which often constitutes a very considerable portion of the tin veins. Very different is the structure of the lodes which are called "ribboned," or "banded," where you have a number of different materials, occupying definite positions in the walls of the lode; sometimes it may be that they occur only on one wall, and then we must exercise a little judgment as to whether that is not due to some movement, and, indeed, we shall find that in many cases we have evidence of such movements having occurred. Here you have a specimen of this banded character, where you see the walls of killas, or hard slate, then a band of quartz, and alongside of it a well-marked band of tinstone, then quartz again, and lastly the killas. In some of the Derbyshire veins you may see sometimes a great number of these bands arranged side by side, chiefly of sulphate of baryta and galena; in some Freiberg specimens where you have bands of iron pyrites, zinc-blends, galena, and quartz, as many as 19 to 20 successive layers have been counted. There is one other condition of the matter within the lodes to be noticed—"breccia"—that is a mass containing the angular fragments cemented together; these particles are derived from the rock forming the walls of the vein, and this occurs sometimes after the vein was formed, because you may see particles of the mineral itself inclosed in the brecciated mass. The cementing matter may be non-metallic, as calcspar, quartz, or fluorspar, or metallic, as iron pyrites and carbonates of copper; in the district of St. Just we have as a rarity feldspar along with mispickel as the binding agent. All these facts help us in considering the theory of the veins.

TO BE CONTINUED.

RAILWAY RESISTANCES.*

By P. H. Dudley, C. E.

(*See Supplement.*)

IN giving a brief account of the experiments in progress to inquire into some of the facts in regard to "railway resistances," recently commenced upon the Lake Shore and Michigan Southern Railway, with the Dynagraph, which is essentially an instrument recording upon paper the force required to draw a train, at all speeds, marking the time in short intervals, so that the force absorbed due to any change of speed can be readily computed, I am well aware that but few of the members are directly engaged in railway construction; yet as all are interested in efforts to reduce the cost of transportation between the mines, manufacturing and agricultural industries of the country, I trust that the account will be of interest and importance to us all. We commenced using the Dynagraph last November, and, while it may seem a simple thing, it has taken a long time to properly understand and interpret the record as made upon the paper.

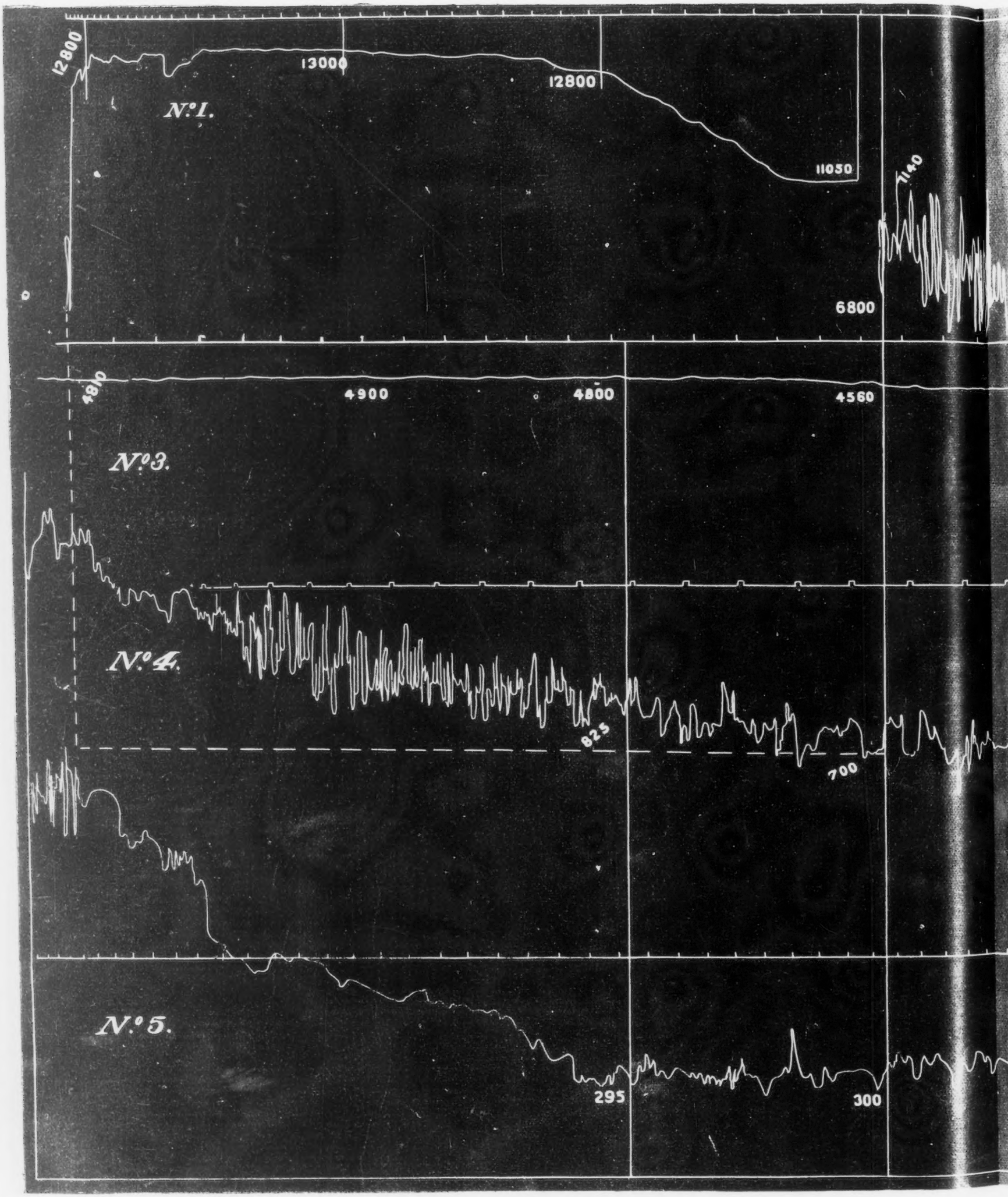
Although only connected to the locomotive by the ordinary link and pin, every movement of the lever of the throttle valve and of the reversing lever are at once indicated and recorded; and upon heavy freight trains opening of cylinder cocks is generally shown. Each locomotive and engineer gives the record a distinct invidualty; the former depending upon its condition and the latter his ability to run even and steady. To eliminate the latter irregularities we now have the same engine and engineer in making experiments with single cars and short trains. It took time to find out all this, and as soon as the track became soft from the excessive wet weather we had in the vicinity of Cleveland during the Winter, it gave us new indications to study and interpret. Now, by passing over a track we can tell whether it is in good condition, or whether the engines are working properly or not, as to the admission and release of steam in the cylinders. The latter indication is much more difficult to determine than any other, as it makes a record similar to that of a rough track.

The Lake Shore and Michigan Southern Railway has a double track of steel rails, well ballasted and in fine condition. From Cleveland to Erie it is nearly all tangent, the grades not exceeding 16 ft. per mile. The radius of curvature very large, ranging from 2,000 to 20,000 ft., with but one or two short curves of the shorter radius. With a stock train of 709 tons (of 2,000 lb. each) at a speed of 16 to 18 miles per hour, the resistance upon a straight line was from 6·5 lb. to 7·1 lb. per ton. Box cars of same weight of train did not differ much as to resistance per ton. The cars were mostly of the Lake Shore and Michigan Southern Railway construction. Chilled iron wheels, 33 inches diameter, broad tread, covering about 1⅛ of an inch in 4 inches; weight 550 lb. Journals ranging from 2⅞ to 3¼ inches in diameter and 5½ inches l ng. For oiling they use petroleum nearly in a crude state. Two styles of brasses are used, both when new (and designed to do so when worn), bear on the journal their entire length; but one brass only bears in the center about two inches against the upper part of the box, and as the brass wears thinner by the pressure, springs off the journal at the ends, and a short bearing is left in the center, and without great care is liable to heat and get to cutting. It is not uncommon to find a journal worn a quarter of an inch smaller in the center than at the shoulder and collar. The other brass has a good bearing upon the top of the box, the entire length of the journal, and seems to wear better, do more service, and run easier when old than the kind first mentioned. In all of the experiments with single cars we found, when light, that those which had a six inch brassing, with same size of journal (3¼ inches,) ran easier than those with shorter journals. The system of lubrication seems to be somewhat deficient. The waste catches the brass which is ground off, mixing with the oil, and it is constantly being used over and over again, keeping the journal in simply an unctuous state and not in good condition of lubrication. We took cars, which were said by the carman at the FORD'S, to be in good condition, the oil and worn brass was all mixed together, like a thin paste, and had some fresh oil turned into the boxes, decreasing the power required to draw the cars, from 10 to 20 per cent. One great object we had in view when we constructed the Dynagraph, was to test the friction of various kinds of coal equipment in use in the Eastern coal districts, as well as that used West, where the car is 28 feet long over all, with 18 inch sides and weighs from 80 to 95 per cent. of the coal carried. Very few of them have dumper bottoms, and those which have only permit a small quantity to run out, without shoveling. In the Eastern States, many varieties are in use having dumper bottoms, and only weigh from 50 to 55 per cent. of the coal carried. A car in which the dead-weight is reduced 30 to 40 per cent., other conditions being equal, would materially reduce the cost of transportation on Western coal, and be of advantage to the producer as well as to the consumer. Our Western coal cars, for some unexplained reason, do not seem to draw any easier than box or stock cars, at speeds of from 12 to 15 miles per hour. Our coal roads are very crooked, and in curving, the longer cars offer more resistance than the shorter ones. The construction of the trucks, and the manner of bearing upon the transoms, have much to do with the ease in curving. After we had made some experiments upon the movement of trains upon the Lake Shore and Michigan Southern Railway, we came to the conclusion that those long and heavy trains of 700 to 750 tons could be run with less fuel at the rate of 18 to 20 miles per hour, than they could at 12 miles their regular time-table rate. On December 3rd, 1875, a stock train of 709 tons was run through, at the rate of 20 miles per hour, and on December 13th, 1875, a train of same weight, with same kind of journals, was run at the rate of 12 miles per hour. It was, however, 17° Cent. colder. The difference in coal used by the same engine was 1,485 lb. The colder day required some of the additional coal, but not the difference made. Subsequent experiments have all corroborated the first conclusions.

After the inertia of the train is overcome, which, in the long trains, seems to be about a speed of twelve miles per hour, the cut-off is moved back, the steam used more expansively, and the light gradients, at the increased velocity, are overcome much more easily than at the slower rates, which, to use an engineer's expression, "becomes a drag to pull the train," when running too slow. To what extent this will be found true upon other roads, using their steam in a different manner, hauling shorter and lighter trains, must be determined by future experiments. The increased damage to machinery, running at the increased speed, must also be taken into consideration. It is a subject worthy of much careful investigation, as it would add largely to the capacity of the road, a much more rapid transit of freight, more service with the same number of cars, and less time on the road for the men on trains.

We do not find it true that the power to move trains increases with the square of the velocity. On some simple cars it only increased to that due to the square of the velocity of the wind acting on the frontage of the cars, the friction of the

* A Paper read before the American Institute of Mining Engineers at the Washington Meeting, February, 1876.



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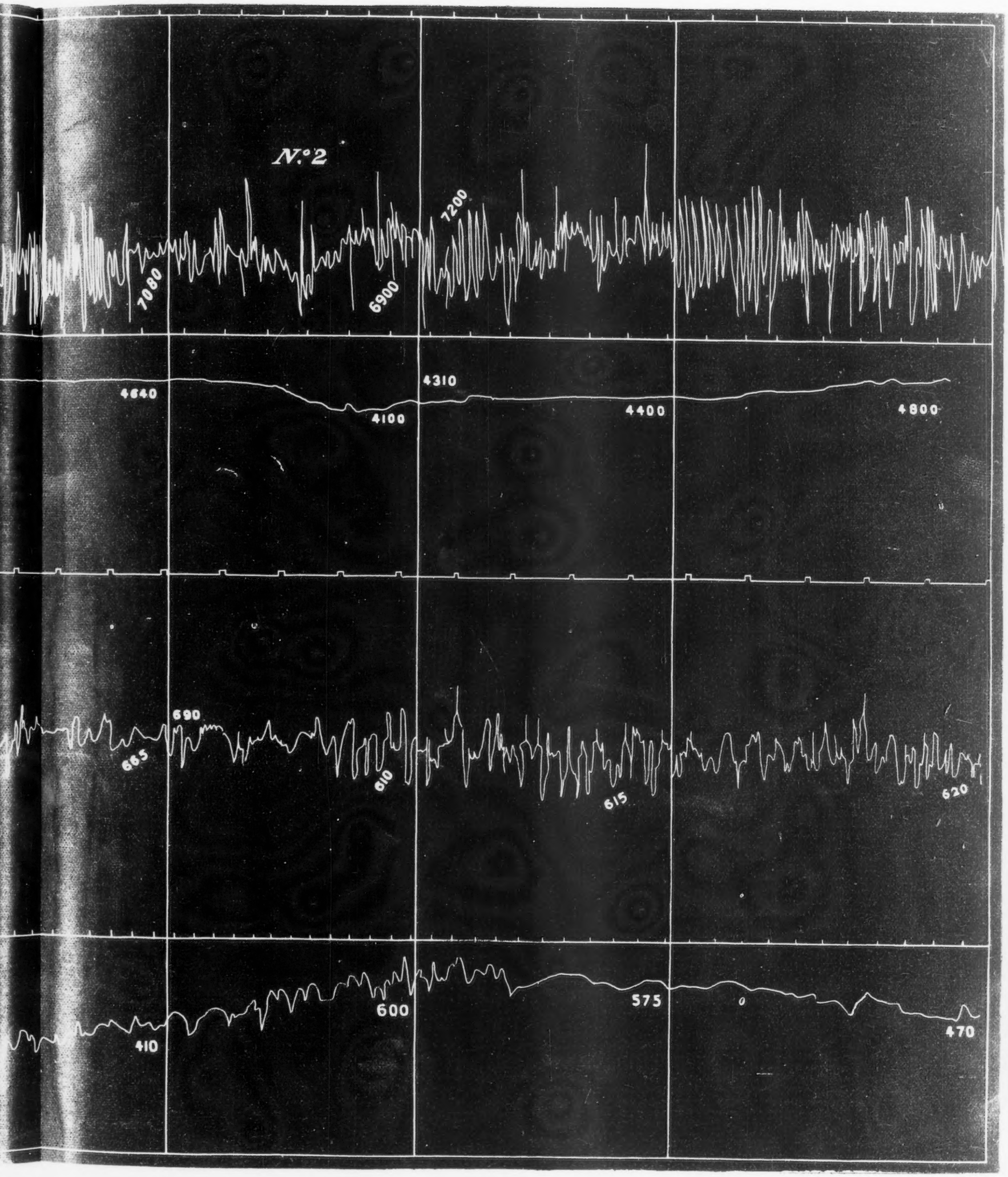


RESISTANCES IN P. H. Dudley, C. E.

car remaining almost a constant quantity. I do not think it will hold good for all the various kinds of car construction, as some are decidedly faulty in all respects as to a minimum amount of friction. The amount of power used to draw the stock train from Cleveland to Erie, 95½ miles, was 2,498,396,320 feet-lb., beside that required to move the locomotive itself. 8,425 lb. of coal was used, each pound giving 296,545 feet-lb. of power, 3 per cent. of the chemical value of the coal. The extra power required to overcome the *inertiæ* of the train on a level, was in one instance 35,696,950 feet-lb., which may be considered a fair average of the power lost each time this train was stopped. Dividing this by 296,545, the amount of power developed by 1 lb. of coal, and it will give the number of pounds of coal used to start this train, which in this case was 125. The same amount of power on a level would send the train two miles, and it requires from two to two and one-half miles to get the train under motion. I introduce this here to show the great loss which occurs in stopping heavy freight trains. More particularly at grade railway crossings, which upon the line under construction, taking the expense of fuel, water and watchmen for 50 trains per day, amounts to 45 cents for each stop, without taking into consideration the extra wear of rolling stock, track, detention of trains, and the constant danger of accident.

The most notable increase of resistance of trains was found in passing over the Cleveland and Pittsburg Railway having an iron rail with the joints from ⅛ to 1¼ inches lower than the center of the rail. Most of the joints were opposite.

Besides the power which would on a good steel rail be required to draw the train, the increase due to the shocks ranged from nothing to 4,000 lb. In computing the cost of moving freight over such lines, the extra wear of machinery and track must be added to the expense of the augmented power required by the rough track. The iron rail does not have sufficient elasticity to return to a normal position at the ends, but takes a permanent set to some extent from each wheel as it passes over it. The ordinary fish-plate is entirely inadequate to make a good joint, sustaining the ends of rails as they should be, to make a good track, on many of our shallow ballasted roads. Passenger coaches are made to ride so easy that the principal officers of the rough lines do not get sufficient jostling and jolting to remind them of the shocking condition of many of the iron tracks. We have not worked up many of the results, as we find every detail of car construction, track and locomotive construction, will have to be taken into consideration, also many of the features of management I do not expect that we can make formulæ which will be applicable to all roads, as nearly every road has its distinct features. We do not expect to revolutionize everything connected with railways, but facilities are afforded and attention paid to the facts developed. Many things connected with transportation may be cheapened. I am trying to find out facts, and not to support any system or plan of moving freights upon railways. I will very briefly explain some of the features of the diagrams.

DESCRIPTION OF ILLUSTRATED SUPPLEMENT.

The Dynagraph is an instrument designed to measure and record upon paper the resistance due to the movement of trains; also shows by the kind of line made, the general condition of the track and motive power. It is fitted into a car which is attached next to the locomotive, and is of the following described general construction; underneath the car is a steel cylinder filled with oil, having two pistons, one four inches and the other one and one-fourth inches in diameter; so arranged that either one can be used at pleasure. The draw-bar of the car is extended back and draws directly on the piston, which forces the oil in the cylinder through a pipe to a small cylinder, in which is fitted a piston, acting against springs of known tension. The cross-head of the small piston moves the levers, carrying the pencil, which records upon the moving paper the amount of force exerted. The paper used is ten and three-fourths inches wide and is in lengths ranging from one hundred and fifty feet to four hundred feet.

The paper is moved by direct motion from the car axle. It is wound upon a drum upon one side of the instrument, and passes through between two steel rollers, over a little table about one foot square, through another set of steel rollers, and thence to another drum, which winds up the paper as it passes through the rollers. Usually one-fourth of an inch of paper is made to represent one hundred feet on the track passed over. An Electrical Chronograph records the time every seven and one-half seconds, consequently the speed for any given instant can be calculated, as it is necessary data in making the calculations.

EXPLANATIONS OF THE DIAGRAMS ON THE OPPOSITE PAGE.

The force line and chronograph line are full size as to length, but in order to get so many diagrams on one sheet the vertical distance between the zero line, force line and chronograph line are reduced to suit the engraving.

No. 1, No. 2, and No. 3 were taken with the large piston on heavy freight trains. No. 1 was taken upon the Lake Shore and Michigan Southern Railway, and shows the force required to start a train of thirty-five loaded cars, one caboose and Dynagraph car. Total weight, seven hundred and nine tons. About three thousand feet in length are represented.

The zero line of force for this diagram is the broken line extending partly through diagram No. 4.

The chronograph line for this diagram is the upper one on the sheet, and the one immediately under it the record of force required to start the train from the Union Depot at Cleveland, Ohio. It was a Mogul engine, having forty-nine thousand six hundred pounds upon the drivers, and would pull from one thousand to one thousand five hundred pounds more than that shown upon the diagram before slipping her drivers, upon a good rail.

The slightly irregular line at first is due to a slight movement of the throttle valve by the engineer, while the downward movement of the force line in the last one thousand feet is due to the speed of the train and cutting back the reversing lever.

The figures upon the force line show the pounds of force exerted upon the draw-bar to draw the train, per instant.

No. 2 represents four thousand feet in length, run by an ore train upon the iron rail of the Cleveland and Pittsburg Railway. Weight of train, three hundred and thirteen tons. The zero line is the same as that of No. 3, which is also the chronograph line of No. 4. The speed of the train is shown by the upper chronograph line.

The vibrations of the force line were caused by a rough iron track, the joints being very much depressed. These vibrations are very much below the average; as many of them were so great the various ones could not be easily distinguished, much less engraved; to check them were obliged to use a spring draw-bar.

No. 3 is the same train upon the Lake Shore and Michigan Southern Railway, as No. 1, when running along at its usual speed, which is shown by the chronograph line drawn through No. 1 and No. 2. It will be noticed the force line is quite uniform, which we found to be so when the track (steel rail) was in good condition, well ballasted, and the engine in good order; but when otherwise the force line assumes the character of that shown in No. 2.

Diagrams No. 4 and No. 5 are some of a series of experiments with two or three cars, and represent starting them and a run of about one and one-half miles. The cars were two loaded Empire cars, and with the Dynagraph car weighed fifty-two and fifty-five one-thousandths tons, of two thousand pounds each. The engine used to draw them is a small one, having a single pair of drivers, and the tender is rigidly attached to the engine, and when running is constantly oscillating from side to side, which gives the force line a vibratory motion. No. 4 was run at twenty and nine-tenth miles per hour, and No. 5 (same train) was run at eight and seven-tenths miles per hour.

The chronograph line of No. 4 shows as it appears when a train is running fast, though somewhat exaggerated in this.

After the diagrams are taken they are all calculated, and the number of foot-pounds obtained required to move the train for the run or any given distance.

REPORT OF THE COMMITTEE ON RAILWAY RESISTANCES.

To the American Institute of Mining Engineers:

THE committee appointed at the February meeting upon Railway Resistances would respectfully report:

That our person has been constantly employed in calculating the results of the data which was taken prior to March 1st, 1876. Also to complete the data taken upon the Lake Shore and Michigan Southern Railway, a diagram was taken on a through freight train from Cleveland to Chicago, and one from Chicago to Cleveland. So that now we have diagrams from Buffalo to Chicago and return, which, when fully worked up, will give results of the utmost importance in determining the cost of transportation of freight. These data will be of much importance in determining the proper methods of equating grades and curves, which is so essential in the location of new lines.

The calculations show that instead of our attempting to formulate results from data obtained on one road, it will be best for the interests of transportation to enlarge the scope of our inquiries, and to extend the experiments so as to include all of the mere probable causes which affect the cost of transportation. Were the details of railway equipment constructed alike, much work, which is now necessary, would be saved.

It is not uncommon to find upon the same road 10 to 30 different patterns of the same thing in construction to subserve the same purpose, which more or less modifies the friction of the cars. Take the majority of our trunk lines, and with this diversity of construction, together with the varying conditions of track and manner of operating and it will be at once seen that the labor and time to do the work and arrive at correct conclusions will occupy from two to three years. The results already attained in the short time in which they have been carried on, wholly by private enterprise, simply show what may be expected when given the aid necessary to render them of the highest value to the great industries of the country. That the information may be general and of the greatest importance to our railway interest, the committee deem it advisable to secure, so far as may be, the co-operation of all the leading railways of the country, and have them assist in carrying on the work now inaugurated, as in that way it would reduce the cost to each road to a minimum and still give them all the full benefits of the work done upon other roads as well as their own. Some of the leading Eastern and Western railways have been solicited to aid, and we think we can without doubt secure their co-operation as soon as they fully understand its importance and value to their own interests. "Large bodies move slowly," especially towards scientific investigation. There will appear for publication with this paper several sheets of data and calculations embracing nearly all of the experiments made with single cars, constructed at the Collinwood Yards of the Lake Shore and Michigan Southern Railway, eight miles east of Cleveland, O.

The track is all tangent and ballasted with gravel. It was about 1¾ inches long between the switches and laid with steel rail.

All calculations were made from the diagrams as shown between the 8th and 9th mile post. The line has two gradients requiring 3·6 lb. of force to overcome these, in addition to that given in the calculations.

In each experiment we endeavored to run each car or cars first at a speed of 10 miles per hour, then at 20, and then at 30, but from the short distance to run before acquiring speed to pass the 8th mile post it was found impossible to run the cars exactly as desired. We did not allow the engineer to change his throttle valve, or reversing gear, after passing the 8th mile post, so that there would be no changes of force due to increase or decrease of steam pressure, as such changes are at once recorded upon the paper, and would be liable to be ascribed to some other cause.

The locomotives used for these experiments are quite small ones, having a single pair of drivers, the tender and foiler rigidly connected, and they do not run steadily but are in constant oscillation, making the diagram somewhat uneven. As the runs could not be made with uniform velocity, we had to reduce them to a basis of uniform speed. It will be noticed in the tables that there is a column of initial velocity, which is that of passing the 8th mile post, and one of final velocity, which is that of passing the 9th mile post. The chronograph, which registers the time every 7½ seconds, shows whether the velocity is being accelerated or retarded, and at what points. The cars experimented upon were such as we found in daily use at the yards. In the final resistance given in the sheets that due to the air is included. As yet we have not been able to use any thing which gives uniform results as to the effect of the wind, though we have used the most sensitive anemometers and vanes.

It is thought the difference is largely due to the eddies which are formed by whatever we attempt to use in connection with the motion of the car. We cannot explain many anomalies which occur in the results of single cars. Some of them are doubtless due to difference in the engineers who ran the engines, and to sudden changes of wind. The diagrams in which they occur do not indicate that any thing was wrong with the working of the instrument, yet it is possible that such was the case. The service upon the instrument with single cars is much more severe than when drawing a heavy train, as the piston is so much smaller for that work. The strain upon the pipes and joints often exceeding, in steady work, 2,000 lb. per square inch, and adding that due to shocks, makes it very difficult to keep the instrument in proper order, without constant care.

We find, in all our experiments, when the weight of the cars is partially carried upon the ends of the truck frames, that after passing curves or switches they oftentimes run long distances before they will straighten up and properly

EXPERIMENTS MADE WITH THE DYNAGRAPH, AT COLLINGWOOD, OHIO, BY P. H. DUDLEY, UPON LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY.

WITH SINGLE EMPTY CARS.

Car, Kind.	No.	To what Railway belongs.	Date of Experiment.	Size of Journals.	Weight of Load, in Tons 2,000lb., includ'g Dynagraph Car.	Velocity in Feet per Second. Initial.	Final.	Difference.	Average Speed in Miles per hour	Resistance in lbs. per ton. Observation corrected for Level Track	Uniform Velocity	State of Weather.	Temperature.	Wind. Height of Barometer	Wind. Direction.	Wind. Velocity in miles per hour.	Remarks.
				in. in.													
Box D....	9,109	L. S. & M. S.	Jan. 31.	3¼ × 6	18.225	16·5	19·6	3·1	11·7	5·44	4·74	Fair.	22°	30·17	S.S.E.	12	Journals badly worn, from 1-16 to 3-16 of an inch. Worm from the various ones; oiled with petroleum.
" "	"	" "	" "	" "	"	37·6	40·1	2·5	21·1	10·84	9·61	"	"	"	"	12	
" "	"	" "	" "	" "	"	28·7	28·3	0·4	19.6	6·97	7·12	"	"	"	"	12	
Box.....	7,866	N. T. C.....	" "	3¼ × 6¼	20.205	18·31	14·00	4·31	14·3	0·38	0.51	"	"	"	"	12	From some unexplained cause the resistance appears to bevery low on this car, though everything seemed to be in perfect order about the instrument. Brasses worn somewhat, the journals varying in size from wear.
"	"	" "	" "	" "	"	27·65	28·08	0 43	19·2	3·79	3·64	"	...	...	....	12	
"	"	" "	" "	" "	"	32·96	42·57	9.61	26·5	12·57	7·93	"	.....	.....	.....	12	
Box D....	9,312	L. S. & M. S.	Feb. 1	3⅛ × 5⅛	2.029	18·95	18 17	0 78	12·5	3·93	4·11	"	38°	29·71	S.S.E.	11	
" "	"	" "	" "	" "	"	27·34	31·51	4·17	20·4	9·31	7·64	"	"	"	"	"	
" "	"	" "	" "	" "	"	35·22	47·7	12·29	29·1	17·39	11·40	"	"	"	"	"	
Stock D..	5,298	" "	Feb. 2	2⅞ × 5½	2.02	15·0	14·33	0·67	9·4	4·45	4·58	"	10°	30·15	West.	29	
" "	"	" "	" "	" "	"	28·83	32·64	3·81	20·8	11·45	9·95	"	"	"	"	"	
" "	"	" "	" "	" "	"	36·72	46·50	9·82	29·4	22·94	17·51	"	"	"	"	"	
" "	"	" "	" "	" "	"	20·0	17·00	3·00	11·9	3·07	3·77	"	"	"	"	"	Newly oiled.
" "	"	" "	" "	" "	"	28·0	30·33	2·33	20·4	10·77	9·90	"	"	"	"	"	
" "	"	" "	" "	" "	"	38·42	47·87	9·45	30·0	24·2	18·96	"	"	"	"	"	
Box D...	13,226	" "	Feb. 3	....	2.000	14·00	14·42	0·42	9·2	7·6	7·53	Cloudy.	10°	30·23	S. E.	13	
" "	"	" "	" "	" "	"	27·73	34·00	6·27	22·3	13·6	11·13	"	"	"	"	"	
" "	"	" "	" "	" "	"	36.31	47·06	10·75	29·5	22·69	17·02	"	"	"	"	"	
Box.....	25,684	B. & O.....	Feb. 10.	2 13-16×5½ 10 3 1-16×5½	19.895	17·75	15·66	2·09	10·4	4·79	5·23	"	"	"	"	"	
"	581	M. D. T. Co.	" "			28·27	32·56	4·29	20·9	7·82	6·16	"	"	"	"	"	
"					2.016	16.75	14·28	2·47	9·7	5·78	6·27	"	"	"	"	"	
"						28·27	32·00	3·73	21·3	11·99	10·55	....	....	....	"	"	
"						34·75	46.77	12·02	28·2	20·9	14·64		....	....		....	

WITH TWO EMPTY CARS.

Box....	9,109 / 9,312	L. S. & M. S.	Jan. 31..	....	28.715	17·75	20·94	3·19	11·6	3·58	2 79	Fair.	22°	30·17	S.S.E.	12	
"	"	" "	" "	"	"	29·57	32·50	2·93	21·1	7·88	6·71	"	"	"	"	"	
"	"	" "	" "	"	"	24·39	25·84	1·45	17·0	4·41	3·95	"	"	....	....	....	
"	"	" "	" "	....	"	35·81	46·92	11·11	28·9	17·33	11·44	"	"	"	"	"	
Box D..	9,312 / 3,706	L. S. & M. S.	Feb. 1....	....	28.655	10·00	9·40	0·6	6·0	3·68	3·82	....	38°	29·75	S.S.E.	11	
" "	"	" "	"	....	....	21·08	19·11	1·97	13.1	4·48	4.98	....	"	"	"	"	
" "	"	" "	"	....	....	26·50	33·23	6·73	20·6	11·66	9·08	....	"	"	"	"	
" "	"	" "	"	....	....	36·7	47·2	10·5	29·3	18·43	12·78	....	"	"	"	"	
Box.....	3,278 / 7,866	N. T C.....	"	....	29 9	16·10	13·27	3·83	8·6	3·69	4·39	....	"	"	"	"	
" "	"	"	"	....	"	26·20	30·60	4·40	19·6	12·05	10·46	....	"	"	"	"	
" "	"	"	"	.....	"	22·00	20·30	1·70	14·1	3·40	3·85	....	"	"	"	"	
" "	"	"	"	...	"	36·21	45·66	9·45	28·2	17·26	12·32	....	"	"	"	"	
Box D..	13,226 / 14,031	L. S. & M. S.	"	....	30.2	16·62	15·66	0·96	10·9	5·9	6·1	....	"	"	"	"	
" "	"	" "	"	....	"	25·47	29·33	3·86	19·2	10·51	9·16	....	"	"	"	"	
" "	"	" "	"	....	"	35·87	48·07	12·20	30·00	23·37	16·83	....	"	"	"	"	
" "	5 298 / 6,689	" "	....	....	30.315	16·86	17·00	0·14	10·3	5·53	5·50	....	"	"	"	"	
" "	"	" "	....	....	"	22·66	26·40	3·86	16·66	10·32	9·15	....	"	"	"	"	
" "	"	" "	....	....	"	35·00	45·50	10·50	28·2	23·48	18·08	....	10°	30·15	West.	29	

WITH THREE AND FOUR EMPTY CARS.

Box....	9,107 / 9.312 / 3,706	L. S. & M. S.	Jan. 31	....	37.08	18·88	20·37	1·49	12·6	3·82	3·44	Fair.	22°	30·17	S S.E.	12	
"	"	" "	" "	....	"	27·79	30·21	2·42	20·3	7·50	6·60	"	"	"	"	"	
"	"	" "	" "	....	"	35·09	44·36	9·27	27·7	17·17	12·43	....	....	....	...	...	
"	"	" "	Feb. 1....	....	"	17·0	15·7	1·3	10·8	4 15	4·42	Wet R'il	38°	29·75	S.S.E.	11	
"	"	" "	"	....	"	33·78	38·18	4·40	25·3	12·65	10·62	" "	"	"	"	"	
"	"	" "	"	....	"	36·45	46·50	10·05	30·0	20·30	14·94	" "	"	"	"	"	
Box....	3,278 / 7,866 / 2,912	N. T. C.....	"	....	39.675	24·55	20·32	4·23	15·0	3·37	4·58	" "	"	"	"	"	Axles much worn, varying from 2⅞×6½ to 3 1-16×6⅞ inches, brass 6 inches long.
"	"	"	"	....	"	25·94	30·78	4·84	19·5	9·2	7·45	" "	"	"	"	"	
"	"	"	"	....	"	32·67	47·33	14·66	27·9	21·97	14·48	" "	"	"	"	"	
"	"	"	"	....	....	34·41	42·07	7·66	25·66	16·38	12·64	" "	"	"	"	"	
Box....	5,288 / 6,689 / 7,813	L. S. & M. S.	Feb. 2....	....	3.951	18·8	18·5	·03	13·3	6·80	6·87	Fair.	10°	30·15	West.	29	Axles and wheels much worn, axles varying from 2⅞×5½ to 3 1-16×5⅛ inches.
"	"	" "	....	....	"	28·0	31·3	3·3	20·9	12 65	11·40	"	"	"	"	"	
"	"	" "	....	....	"	36·10	46·50	10·4	29·5	23·43	17·93	"	"	"	"	"	
Box....	5 298 / 6,689	" "	Feb. 2....	....	49.585	20·1	15·3	4·8	11·2	4·87	5·95	....	....	....	....	....	Axles much worn. See above.
	7,813	" "	"	....	"	30·3	34·7	4·4	22·6	19·85	18·03	....	....	....	....	....	
Box.....	9,198	N. T. C.....		....	"	35.6	48·2	12·6	29·3	24·57	17·82	....	....	....	....	....	

ONE AND TWO LOADED CARS.

Box.....	1,475	B. & A.....	Feb. 25...	....	27.61	16·61	15·24	1·37	9·5	3·79	4·06	Clear.	17°	30·11	S.S.W	12	
"	"	"	"	....	"	20·87	16·17	4·70	13·2	1·98	3·06	"	"	"	"	"	
"	"	"	"	....	"	24·91	26·17	1·26	18·0	4·2	3·80	"	"	"	"	"	
....	....	....	....	....	"	26·00	27·12	1·12	18·5	3·62	3·25	"	"	"	"	"	
....	....	....	....	....	"	17·64	17·19	0·45	11·6	2·76	2·86	"	"	"	"	"	
....	....	....	....	....	....	24·89	30·60	5·71	18·6	5·98	4·01	"	"	"	"	"	Newly oiled.
Coal D.	13,226 / 14,031	L. S. & M. S.	Feb. 3 ...	....	45.35	18·41	16·1	2·3	10·8	4·75	5·24	Cloudy.	10°	30·33	S.E.	13	" "
" "	"	" "	"	....	"	27·6	34·4	6·8	21·8	14·62	12·00	"	"	"	"	"	
....	....	....	....	....	....	35·53	49·30	13·77	28·6	22·11	14·83	"	"	"	"	"	
Box....	3 277 / 3,744	Empire.....	Feb. 4....	....	52.55	15·5	17·0	1·5	8·7	5·94	5·64	Fair.	17°	30·28	West.	20	
....	....	....	....	....	....	27·12	32·82	5·70	20·9	9·79	7·69	"	"	"	"	"	
"	5,635	S. & I. R. E.	....	....	....	33·78	46 00	12·22	28·2	19·12	13·10	"	"	"	"	"	
....	8 293	L. S. & M. S.	Feb. 23.	2 13-16×6 3 1-8×6	48.06	23·69	27·46	3·77	17·8	11·77	10·57	Clear.	5°	30·39	N.NW	20	

troch, and not bind upon the flanges of the wheels, thereby causing increased friction, which often shows in the results of our experiments. It is seldom that we find journals upon the same cars of the same size, the wear is not uniform, ranging from 1-16 to 5-16 of an inch on the different journals of the same car. Flanges of wheels are often badly worn upon opposite wheels and the axles are not parallel. There does not seem to be any uniformity as to the width and length given to bearings, some will have two inches and two and one half in width, the length varying from five to eight inches. As a rule we

have found that a bearing of six inches in length runs easier than one of five, and is not so liable to heat.

In loaded cars, especially after standing some time, the lubricant seems to be forced from between the journal and brass, so that the car needs to be run a short distance, or newly oiled, before it will run at the usual friction. The friction seems to be higher per ton in loaded cars than in empty ones. We have not as yet attempted to formulate any of the information we have obtained, deeming it of importance to gain more before reaching definite conclusions. It will doubtless be necessary to have constants to apply to a general formula for the variously constructed cars, or to have distinct formulæ for them. In all of the experiments detailed upon the sheets or tables, petroleum was used as the lubricant, excepting that of the Baltimore and Ohio car, which was a kind of grease used by that company. This car had 30 inch wheels, all the others 33 inch wheels. In making further experiments with single cars, every detail of construction which can affect the resistance of the car will be taken into consideration, for the purpose of finding out what is best, and to initiate a system of uniform construction for cars intended for the same purpose. The expense to the Great Trunk Lines in keeping so much stock on hand to repair cars of different construction is a very large tax upon transportation.

The experiments upon heavy trains furnish the most accurate means of determining the cost of moving freight over the railways. In all instances where it can be done, we take the weight of coal consumed, and by that means have found how much power each pound of coal developed in moving the train. From these data, it will be easy to calculate the cost in fuel of moving freight upon any portion of the line having different gradients, and, what is equally of importance, the cost of making stops. This was mentioned in a previous paper, yet, possibly, some will hear this now who did not then, therefore we will repeat it briefly.

Engine 485 of the Lake Shore and Michigan Southern Railway, developed to move the train, for each pound of coal consumed 296,545 feet-lb. of power, or less than 3 per cent. of the theoretical power of the coal. To start the train, weight 709 tons, and get it under full motion, it took from 20,000,000 to 40,000,000 feet-lb. depending upon the place and circumstances. In one place it was 35,696,950 feet-lb.; dividing this by 296,545, the power developed by 1 lb. of coal, and it gives 120.4 as number of pounds of coal consumed after the stopping of the train to again get it into motion. Take into further consideration the loss of time, and delays to business, and it will be seen that stops are expensive; therefore the time-table should be so arranged, as far as practicable, so that through trains should only stop for water and at terminal division stations and railway crossings. In through lines more attention should be given to the avoidance of grade crossings, not only as a safety measure, but one of economy. In a short time we fully believe that it will be found cheaper in great trunk lines to arrange the freight engines so that they will take water while in motion, or by condensing a portion of the exhaust steam, so as to require but a small part of the water now used. On the Cleveland and Pittsburg Railway (in an ore train run), from Cleveland to Wellsvil e, 1 lb. of coal developed 398,763 feet-lb. to move the train, utilizing in moving the train about 4½ per cent. of the theoretical power of the coal, showing a great gain over that developed on the Lake Shore and Michigan Southern Railway. We consider the values of the different engines given by these experiments of the greatest value, in determining those which are the most economical for freight purposes. It affords a comparison as to the value of the number and different-sized drivers used on the engines; by taking the amount of coal used, and knowing its general characteristics, we are able to judge of the engine in an economical point of view. To show how erroneous it is to compare the work performed upon one road with that of another by the tonnage moved in miles by one lb. of coal, we will state one example of comparison of the Cleveland and Pittsburg Railway and the Lake Shore and Michigan Southern Railway. The run upon the Cleveland and Pittsburg Railway was made with an ore train, from Cleveland to Wellsville, upon which are many long 40 feet grades to reach the table lands of the country through which it passes. On the table lands there are many short 40-feet grades, also sharp curves. The track was iron, joints very much depressed. On the Lake Shore and Michigan Southern Railway the run was a stock train, steel track, and in good condition, the line mostly tangent, the grades not exceeding 17 feet per mile. The average friction per ton of the train on the Cleveland and Pittsburg Railway was 10.72 lb., and on the Lake Shore and Michigan Southern Railway 6.85 lb., the former some 57 per cent. greater than the latter. When we compared the tonnage moved per mile per lb. of coal, they were almost identical, leading one to conclude perhaps that the motive power of one road was operated as economically as the other, whereas in fact, as above stated, the work done upon the Cleveland and Pittsburg Railway per lb. of coal was 50 per cent. greater than upon the Lake Shore and Michigan Southern Railway. The fine effect of steel track in this case is offset by the better adaptation of the motive power upon the other, so that each road would be improved by simply adapting the better principles of the other. It does not afford any accurate test of the economical movement of freight of two roads by a comparison of the tonnage moved in miles per pound of coal, any more than it does of a road to compare the cost of operating to the total receipts. In running trains there are many things which the careful and considerate engineer must do to pull his train over the road to the best advantage for his company's interest, which if rigidly interpreted would be a disobedience of orders. The reason for this, largely owing to the manner of making up the time tables, in not allowing sufficient time in difficult places, and too much where it is comparatively easy. It seems to us more attention should be made to the development within certain kinds of a more uniform development of power. This idea is new, but is very forcibly brought out by a study of the diagrams. In ascending a grade you very soon come to a limit in the power which the engineer can develop, on a given strain. In many instances we have found that upon a grade the engine could not draw the load it had without backing up and acquiring a little momentum to assist it in passing the difficult place. The judicious engineer, instead of running so slowly over such places, takes advantage, and stores up a little momentum in the train to help in a difficult place. We do not approve of any reckless running, but engineers should be allowed to take advantage of those little things which oftentimes determine whether he can get over a grade or not. Having ridden several thousands of miles upon heavy freight trains, we must say that we do not believe it possible to make a uniform time table on our undulating road, productive of the greatest economy.

In a general statement, we give the average friction per ton of 29 loaded and 2 empty cars from Toledo to Cleveland, total weight of 590 tons, at 20 miles per hour, at 1.45 lb. From Cleveland to Erie, of 37 loaded cars, weight 109 tons, speed 20 miles per hour, 6.85 lb., and from Erie to Buffalo, of 25 loaded and 2 empty cars, weight 512.4 tons, the friction was 7.94 lb. per ton. These were upon the Lake Shore and Michigan Southern Railway, and include all the resistance due to gravity and air. On the Cleveland and Pittsburg Railway from Cleveland to Wellsville the average friction per ton was for an oil train of 313 tons 10.72 lb. per ton.

Although stated in the previous paper, we will repeat that with the same engine upon the Lake Shore and Michigan Southern Railway to run a train at 10 to 12 miles per hour from Cleveland to Erie, it required 1,680 lb. more of coal than it did with the same number of cars at 18 miles per hour. Weight of train about 100 tons. Upon further investigation of this question, we have found that the drivers are generally worn more unevenly upon slow running locomotives than fast ones.

We also find the statement that it requires less fuel to run trains at 18 miles per hour than at 12 is corroborated by many leading railway men. The American Society of Civil Engineers has appointed a Committee upon this subject, which will co-operate with your Committee.

WM. P. SHINER,
P. H. DUDLEY.

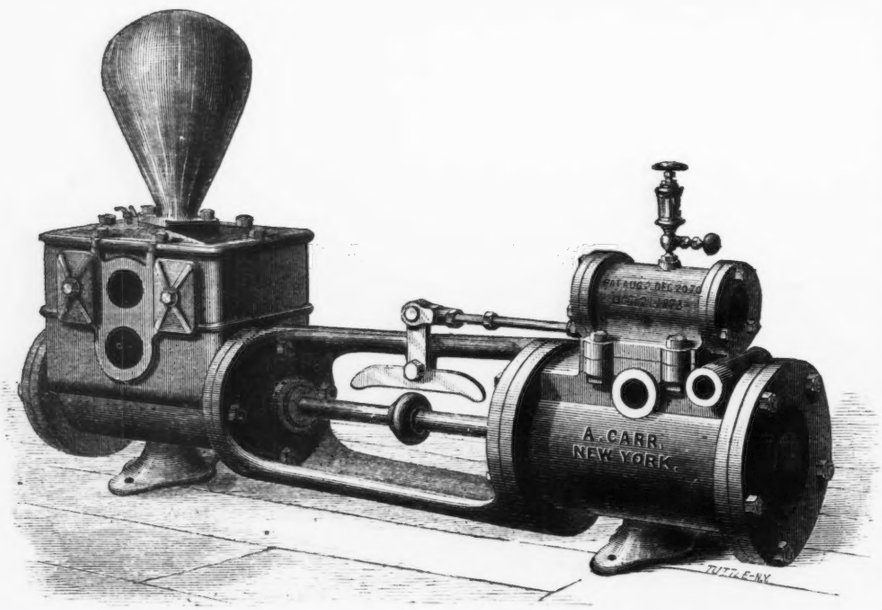
PHILADELPHIA, June 20, 1876.

ON THE CASSON-DORMOY PUDDLING FURNACE.

By E. Fisher Smith, Dudley.

IT is generally confessed that up to within the last few years, but comparatively little attention was directed in Great Britain to economizing fuel. With a low price of coal and dear labor, it is no doubt, in many cases, perhaps more economical to work with the simplest possible apparatus. These conditions were much altered by the great rise in the prices of fuel and raw materials consequent on the sudden revival of trade after the last great war. It may well be doubted whether materials will ever again fall to their old prices, especially as the selling price of finished iron is now out of all proportion low in comparison. Any furnace, therefore, inexpensive to erect, and which can show a clear saving in cost of working, without any fall in quality of produce, must necessarily commend itself to the attention of this Institute as representing the iron trade of the country. Such a furnace, it is believed, we have in that now commonly known as the Casson-Dormoy furnace. It has been attempted, in its construction, to perfect the main features of the old reverberatory puddling furnace at Cort, and to thereby intensify and concentrate its action and diminish its working expenses. At the Round Oak Iron Works, this system of furnace has been tried between three and four years, and three such furnaces have, during the last five months, been producing 90 tons of iron weekly, consuming about 16 cwt. of screened slack per ton, whereas 30 cwt. per ton is usually consumed by the old method, saving about two-thirds in fettling, and from 1s. to 1s. 6d. per ton in bricks and castings. At the same time, the quality of the iron is found to be superior to that made in the ordinary furnaces. This can be seen from the samples exhibited, which were rolled direct from the puddled bars from pigs of the lowest mixture used at Round Oak. Three similar furnaces, at the Tudhoe Iron Works, Spennymoor, have produced even better results; the output being greater and the average consumption of coal per ton for the year being only 12 cwt. The Wigan Forge and Rolling Mills Company, after making their own tests with the furnace, have determined upon laying down the whole of their new forges upon this system in conjunction with the Stoker puddling machine. The Kirkstall Forge and Iron Company, and Messrs. BALDWINS, are applying the system of furnace in combination with the PICKLES apparatus. At Round Oak, a modification of GRIFFITH'S machine has been adopted for the similar new furnaces now in course of construction. As regards fuel, the most economical method in regular use at the Round Oak Works is to screen the slack, to use the screenings in the Casson-Dormoy puddling furnaces, and to burn the fine siftings or dust by means of mechanical stokers under the firing boilers. To begin with a brief general description, it is to be observed that this furnace is of the usual reverberatory form. It consists of three chambers. In the first is the grate, the flames from which pass over the bridge, and are reverberated by the dome upon the bed in the second chamber. The bed consists of a cast basin or dish, resting on a number of iron friction balls, laid in a second pan of wrought iron filled with water, the supply of which is kept up from a jet of about the diameter of a quill. This basin easily adjusts itself on the balls for expansion or contraction, and it may also, when required, be turned about to allow of equable wear and tear. Through the puddling door on each side of the bed, the two mechanical rabbles are introduced, and worked through a small orifice at the bottom. Both doors are lined with Stourbridge clay, and have the usual hole for slag just below them. The third, or preparatory chamber, forms a kind of second bed or hearth; the pigs are heated here almost to melting point by the waste fire gases on their way to the stack. In working the furnace, on the fire being got up, the pigs are put into the preparatory chamber, and allowed to remain till they are on the point of fusion. They are thereupon passed over the flue bridge into the basin by means of a bar, and are then completely run down by the reverberated fire gases from the grate. The rabbles, somewhat bent down at the working end, are introduced from the doors, and the puddling commences. Each rabble is either worked by hand through the orifice or attached to the mechanical puddler. This is of the usual character, consisting of vertical reciprocating lever, which can be connected at will and driven by a crank and suitable spur gearing, erected on a frame above the dome of the furnace. As soon as the metal becomes pasty and adhesive, the rabbles are withdrawn, and the iron "balled up" and shingled in the usual manner. The furnace is double, and the grate is fitted with a cast iron plate of the full width of the furnace, and sloping upwards to the bridge at an angle of 30°. The back of the grate also slopes to an angle of about 30°, and is constructed of cast iron fire-bars set close together. The bottom is also formed of ordinary round or square bars. Blast is admitted about 5 inches below the bars on each side, the bottom being kept air-tight, as also the sloping back; this back has a drop door to enable the underhand occasionally to prick the bars. The area of the gate is only 5 ft. 10 in. × 1 ft. 10 in., being somewhat less than that of an ordinary single furnace. The main object of the sloping plate is to prevent any clinkers forming at the back, as the blast of air keeps it cool. The grate is fed in the usual way. The puddling basin rests on a brick pillar about 1 ft. 4 in. from the ground. On this is first set a wrought iron circular open dish with sides above 3 in. deep; within this dish, eight or more friction balls, five inches in diameter, are placed at equal distances from each other. On these spheres, two cast iron semi-circular plates are laid. On these plates again, four side or segment plates are set, bolted together externally by means of wrought iron pins, and forming a complete circle. Upon these are placed loosely the shelf or table plates, which, resting upon brackets fixed to the rail

buckstaves, support the walls of the furnace. All the plates forming the basin are thus free to expand and contract with the variations in the temperature. The dish below being kept full of water, the evaporation produced from the heat above efficiently cools the bottom and sides, and, consequently, the fettling. The furnace is worked in the following way:—The preparatory chamber, besides heating the pigs, serves as a neck to the whole furnace. As soon as the iron is melted, the rabbles, which are so set that they cannot catch in to each other in crossing, are fixed to the machine and worked at the slow motion of about five minutes. This speed is quickened until the iron boils, when the slower speed is put on till the iron drops. The heating chamber is then charged; this is done with a few pigs at a time, so as to enable the iron to get equally heated all through; one pig is kept to the last, in order to be placed near the bridge, thereby keeping the ends of the others from absolutely melting. The rabbles are then removed, and the real work of the puddler begins by his balling up the iron in the usual manner. The balls, which are of the ordinary size, are drawn from each door, and the cinder tapped. A few shovelfuls of hammer slag and scale are thrown on the bed, and the pigs, which have meanwhile been supplied into the preparatory chamber, are again passed over. These generally melt on the bed in ten minutes or a quarter of an hour. The charges of about 19 cwt. usually take from an hour and twenty to an hour and forty minutes. It will be noticed that iron shields are fixed on each side of the doors between the two buckstaves, and about one foot from the ground floor. It is found that the heat of the upper portion of the furnace induces a constant circulation of cold air between the casings thus formed, and the surfaces of the brick walls protect the puddler when the door is drawn up to pick out the blooms. In spite of the important results of this system—results not attained without the usual amount of experimenting—it is not claimed that all the separate features of the furnace present any strongly-marked stamp of originality; the pig or heating chamber has probably been used before, though not, it is believed, worked in the method here adopted now, in connection with a double furnace, and especially not with mechanical rabbling. The peculiar circular bed or basin is perhaps the most original, while it is also one of the most important characteristics of the furnace. By the absence of inequalities and corners, its shape does away with the difficulties usually attending the working of a mechanical rabble, at the same time effecting a considerable saving in the fettling. Precisely stated, the following are some of the most direct advantages of the circular puddling basin:—1st. This circular form easily enables the rabbling to be worked by machinery, as there are no jambs that the rabbles cannot reach in their regular courses from right to left and back again. 2d. The dimensions, as affected by the working, do not vary to any appreciable extent from day to day; this is an important point with all furnaces, but especially with furnaces in which the puddling is done by machinery. 3d. The contours being circular, and the sides and bottom of the basin being free, they scarcely ever crack. The only renewals are of the doors, door frames, and bridge plates. 4th. As the strain of the furnace is almost entirely thrown upon the circular side plates, no external or casing plates are requisite, thus permitting an economical construction of the furnace. The buckstaves consist merely of rails or similar bars. The advantages of a preparatory chamber are:—(1) The saving of time in melting down, which, in this case, means a proportionate saving of fuel. (2) The pigs are freed from the silicious matters derived from the blast-furnace pig bed, and adhering to their surfaces. Ordinarily, this sand is well known to be injurious to the bed of the puddling furnace itself, by wasting the fettling and in other ways. The advantages of the peculiar grate are:—(1) The employment therein of blast, which can be regulated so that the furnace is perfectly under control, and the puddler can obtain either an oxidizing or reducing flame at will. (2) The drop doors and sloping back enable the underhand to prick the bars, and thus clean the grate without disturbing the blast below. (3) It permits the use of screened slack instead of forge lumps. (4) The sloping back grate, cooled behind with blast, prevents the formation of clinker. It would be difficult to exactly determine the indirect or contingent advantages contributed by each separate portion of the furnace, but it may be added that the increased efficiency of the reverberatory furnace has been found in practice to have the result of saving about one-half in fuel, fettling, castings, and bricks. Alterations in an old forge, in which to apply this system, can be made without interfering with its current work or its existing plant, whilst considerable space is gained for ventilation or other purposes, inasmuch as five of these furnaces will do the work of 15 old single ones.



SELDEN'S DIRECT-ACTING STEAM PUMP.

HYDRAULIC MACHINERY AT THE PHILADELPHIA EXHIBITION.—NO. 2.

BLAKE'S PUMPS.

In comparing these pumps with those of the KNOWLES Company, which were described in our first article, the differences to be noticed are confined entirely to peculiarities in construction or arrangement. As has already been stated, the workmanship and material used are of the best character possible. The pumps made by the BLAKE Company are all direct acting, and have the main steam slide valve actuated through the medium of an auxiliary cylinder placed above the valve. The arrangements for operating the piston in this auxiliary cylinder are peculiar to the pumps of this make, and in their present forms are quite effective in operation. Two forms of these valves are used, one when the pumps are small, have the horizontal auxiliary cylinder placed at right angles to the axis of the main piston rod, and the other in the case of the larger pumps, when the auxiliary cylinders are parallel to the main cylinders. When comparing this latter form of valve motion with that used in the KNOWLES pump, one quite important difference is apparent at once. In the BLAKE pump, no stem is connected with the pistons in the auxiliary cylinder, the stems operated by the motion of the main piston rod, being communicated to an auxiliary valve in the main valve chest. The long connected pumps work this auxiliary slide valve by means of an upright tappet arm, which is keyed on to the main piston rod. The upper end of this tappet arm slides on the auxiliary valve stem, which it moves a short distance back or forth, by striking against tappets on their valve stem when finishing the stroke. The movement of this auxiliary valve admits steam to the corresponding side of the auxiliary cylinder above, which has the effect of driving its piston to the other end of the cylinder, by which movement the main valve is opened and admits steam to the principal steam cylinder.

The main piston rod then makes a return stroke, and the other tappet is in turn struck, and the operations in the auxiliary cylinder and valve chest are reversed. One feature peculiar to the piston in the auxiliary cylinder of the BLAKE pump si the use of metallic packing rings, similar to those used in ordinary steam cylinders. The cushioning of the stroke, both in the auxiliary and main cylinders, is effected by the admission of steam through auxiliary ports, before the pistons have traveled through their full distance. The BLAKE Company make a large number of short connected pumps, in which the steam and water cylinders are brought quite close together. The auxiliary valve stem in these pumps are operated in two ways. In one case, a rod passes through stuffing boxes in the adjacent heads of the steam and water cylinders, being alternately struck by the respective pistons. Attached to the middle of this rod is the arm of a lever of the 2d order, to which the auxiliary valve stem is connected.

This arrangement for working the auxiliary slide valve has now been almost entirely abandoned, owing to the trouble which sometimes resulted when there was a considerable difference in pressure between the steam in the steam cylinder, and the water in the water cylinder. It was found that this difference of pressure often moved the tappet rod in a direction contrary to the proper one, and thus interfered with the regular working of the pump. The tappet motion now in general use on the short connected pump, made by this company, is arranged as follows: Two tappet-rods pass through stuffing boxes in either end of the steam cylinder, and bear against the ends of levers similar to the one just described. The auxiliary valve stem is carried out through both ends of the valve chest, and is connected with these levers. In the case of plunger or long connected pumps, a tappet is put on the piston rod so that but one tappet-rod needs to be put in the steam cylinder.

It has been found that unless the auxiliary cylinders have considerable size, their work is not always satisfactory so to remedy this difficulty in the case of the smallest pumps made, the auxiliary cylinder instead of being placed parallel with the main steam cylinder, is placed at right angles to it. The auxiliary valve which is moved in the ordinary manner, is a yoke in which slides the main valve, whose motion is at right angles to the axis of the pump. An upright pin from this valve passed through, and connects it with the auxiliary cylinder above. The water valves used in these pumps do not differ materially from those in general use. The pumps forcing water to moderate heights, have circular valves made of rubber with brass reticulated seats, while those used for heavy mine lifts, or petroleum pipe lines, are composition joppet valves, having seats made of the same metal. These seats are in some of the pumps made on one piece of metal, which is easily removable when repairs become necessary. Two general patterns of mining pumps are exhibited by the BLAKE Company, one being a piston, and the other a plunger pump. The piston pump has a steam cylinder 18 inches in diameter, and a water cylinder of 10 inches diameter. The stroke is 36 inches. The water cylinder is made with a removable casing of gun metal, so that it can be duplicated or repaired with comparatively little trouble or cost. One delivery and one suction valves are used in this pump, each 9 inches in diameter. The plunger pump exhibited is made for raising water in a direct lift of 800 feet. It is double acting, its principal parts having the following dimensions: diameter of steam cylinder, 28 inches; diameter of plunger, 16 inches; stroke, 24 inches. There are four circular suction and four circular delivery valves, 8 inches in diameter, for each plunger. The suction valves are placed below, and the delivery valves above the water cylinder. The valves are made of rubber one inch thick, and are held down to these seats in the center by a bolt, so that when delivering,

they take a cup-like form. The valves are conveniently reached by side holes covered with plates, which are held down by bolts. A considerable variety of pumps for special uses are made by the BLAKE Company, which show a number of novel features in design, but which our limited space will not permit of being noticed. Considered as a whole, the working of these pumps has been highly satisfactory. Possessing, as they do, the qualities which are necessary to the full success of every invention, excellence in materials and workmanship, they at the same time are built in good proportion and on correct principals. Their working parts are simple, and no particular ones are exposed to extraordinary wear. The BLAKE pump is to be ranked among the best of the direct self-acting pumps made in this country.

SELDEN PUMPS.

These pumps have an auxiliary piston to move the steam valves. The motion of this piston is determined by the admission of steam through an auxiliary valve, which slides on the main valve seat. The pumps are made both with long and short piston rods. In the case of the long connected pumps, a cam is placed upon the center of the piston rod, which alternately strikes a long rocker arm which is pivoted at the center, and having an arm extending upward from this center, to which the auxiliary valve stem is directly connected.

The pumps in which the cylinders are set closely together, move the auxiliary valve through the agency of tappet rods at both ends of the steam cylinders, the whole arrangement being similar to the one now in use on the BLAKE pump, and which has already been described.

Inside the valve box, the valve seat contains three parallel and nearly equal sets of ports. The center row of ports is covered by a small valve, whose stem is worked by the lever and tappet arrangement just described. Sliding over and surrounding this valve is the main valve, which covers the two outside rows of ports, and whose upper side has a projecting lug, which fits into the piston of the auxiliary cylinder which is above it. The cushioning of the pistons is effected by the closing of the exhaust ports, before the completion of the stroke.

There is connected with one of the SELDEN pumps which is now on exhibition, a circulating condenser, which holds, without any difficulty, a vacuum of 26 inches. The water from the suction pipe is drawn on its way to the pump through this condenser, and with it is mixed the exhaust steam from the steam cylinder.

The whole condensing apparatus is simple in construction, and must add considerably to the efficiency of the pumps on which it is used. The same apparatus is employed on a compound direct-acting pump, which will be spoken of hereafter. The SELDEN pumps are made both with pistons and plungers. Both delivery and suction valves are placed on the top of the water cylinder.

NOTES.

USE OF RAIL ENDS IN BLAST FURNACES.—According to HEYROWSKY, it has been found, at Zeltweg, very advantageous to add the crop ends from the rail mill to the charge on the blast furnace, and at present, from this reason, the blast furnace at Zeltweg, which formerly only produced 230 tons of gray Bessemer pig iron per week, now turns out 270, the increase of the forty tons in the make corresponding exactly to the quantity of rail ends added to the charge.

UTILIZING WASTE OF GALVANIZED IRON.—A Wolverhampton manufacturer has devized a method of utilizing the waste of galvanized iron, which is described as follows: He prepares from the skimmings of the zinc pots which are used in galvanizing iron an oxide of zinc containing a large percentage of pure zinc oxide by mixing the said skimmings with carbonate, oxide, or hydrate of calcium, or of other alkaline earths, or of the fixed alkalies, and heating the mixture in a retort or other suitable vessel sufficiently to cause a decomposition, resulting in the production of zinc oxide and a chloride of the alkaline earth, or alkali soluble in water. He then separates the soluble substances from the insoluble zinc oxide by treatment with water. Otherwise, instead of heating the mixture as described, he boils it in water and obtains a similar result, when, after allowing the zinc oxide to subside, he draws off the water containing the soluble substances, and washes the zinc oxide with water to separate more thoroughly the soluble impurities therefrom. After the production and purification of the zinc oxide by either method it is dried for smelting or other purposes. The compounds of ammonia given off during either process may be utilized. Those of the carbonates which are insoluble in water are not so effectual or convenient in the boiling process as in the heating process."

PROTECTION IN RUSSIA.—*The Engineer* (London) says: 'Information which we published a fortnight ago touching the encouragement which the Russian Government have determined to afford to steel rail makers in that empire, has to be supplemented by intelligence of yet more importance referring to the whole rail industry. It is stated that the Russian Government have determined to accede the requests of the manufacturers in that country, and to place such impositions upon the importation of rails as will render it impossible for English makers to enter into competition with the Russian rail makers. The following are the measures that have received the sanction of the Government, and which will be made public in the course of a day or two:—(1) That in future a duty shall be imposed upon all imported rails. (2) That all concessions to Russian railway companies shall contain a clause compelling them to use not less than one-half rails of Russian manufacture. (3) To allow a premium to rail manufacturers (4) To give them orders for work extending over four or five years. (5) To give them a special cheap rate of transit not only for their manufactured rails, but also for their ore, pig iron, fuel—in fact, all the materials of their trade. It is further stated that the engineers and tool makers in Russia are moving with a similar object, and that there is no doubt that concessions will be made to them also. More detailed intelligence will be forthcoming in a few days; meanwhile there seems to be reason to assume that, aided in this way, iron and steel production in Russia, together with native engineering, will be more vigorously prosecuted than heretofore, for it should not be forgotten that labor in Russia is exceedingly cheap, new mines of the richest hematite and magnetic ores are being discovered and opened daily, and a great development is being made in mines already opened. The activity which is now being displayed in the working of coal near Khakoff, in the basin of the Donetz, will now probably be augmented at the same time that the other districts known to promise the discovery of workable coal in Russia will be more carefully examined, with a view to the obtaining of the greater supplies of fuel which Russia will require to enable her to make the best of the great help which the fostering care of her Government is affording. In the making up of any deficiency, the Germans with their Westphalian coal will be only to happy too compete with the coal owners of England. It may be taken as certain that the British Iron Trade Association will do its best to reduce the protection to a point at which some chance will be left open to English iron and steel producers, even as the committee of that association is doing its best relative to the new French treaty; but the reply which Earl Derby has just given to the papermakers, who have complained that other countries levy an export duty on paper-making materials, and an import duty on paper, leaves but faint hopes of an appeal too that quarter being of much service. The Foreign Secretary reminded the papermakers that, as a nation, we have now nothing, or next to nothing, to offer to foreign countries in return concessions on their part. "We have adopted," said, his lordship, "no doubt quite wisely, the free trade system, and it is now therefore too late to talk of reciprocity." This fresh intelligence is not very cheering as to the future.

THE COMPOSITION OF FLUE DEPOSIT.*

By J. Blodget Britton.

DURING the last three or four years I have had occasion to examine, chemically, various samples of matter commonly called flue dust or cinder, found deposited in the flues and hot-blast chambers and under the boilers of blast furnaces, and also in the flues and under the boilers of puddling and boiling furnaces.

Recently several of these examinations were made quite in detail, and as the results reveal, I believe, information of no inconsiderable importance, I am induced to communicate them to this Institute.

A sample of deposit obtained from the flues of one of the blast furnaces at the works of the Phœnix Iron Company, at Phœnixville, Pa., was found to have the composition given in column I. of the following table:

Composition of Deposits.	I. Dust from Blast Furnace.	II. Dust from Puddling Furnace.	III. Dust from Boiling Furnace.
Protoxide of iron	1·51	3·08	1·18
Peroxide of iron	20·21	33·29	41·00
Alumina	6·57	12·89	7·54
Lime	3·98	·48	·61
Magnesia	·69	·09	·19
Protoxide of manganese	1·66	·39	.12
Oxide of zinc	2 84	....	....
Oxide of copper	·06	....	....
Silicic acid	36·00	40·69	28·99
Sulphuric acid	7·55	1·05	·43
Phosphoric acid	·94	3·55	2·98
Arsenious acid	·38	....	....
Antimonious acid	trace.	....	....
Chlorine	·03	....	....
Cyanogen	·09	....	....
Ammonia	trace.	....	....
Potash with some soda	16·61	....	.. .
Carbonic acid	·59	....	....
Alkalies, undetermined matter and loss	·29	4·49	6·96
	100·00	100·00	100·00
Metallic iron	15·31	25·70	29·64
Phosphorus	·41†	1·55‡	1·30§

Nickel, cobalt, chromium, titanium, bismuth, lead, barium, fluorine, and several other substances were also specially searched for, but not a trace of either of them could be found.

The ores used were, I was informed, magnetic and brown hematite mixed. The fuel was Schuylkill anthracite, and the flux was the ordinary limestone of the neighborhood.

A sample of similar deposit, obtained from one of the furnaces belonging to the Crane Iron Company, on the Lehigh, afforded of soluble salts of the alkalies nearly 30 per cent. There was detected in it cyanogen and also chlorine, and a very appreciable amount of carbonic acid, but not a trace of ammonia. A full examination was not made, and only the iron and phosphorus were quantitatively determined. Of the former there was 8·20, and of the latter 27, equal to 3·29 of phosphorus to 100 of iron.

Another sample from the hot-blast chamber of a furnace on the Hudson, belonging to the West Point Iron Company, proved exceedingly complex in composition. It afforded 18·67 of potash, 9·81 of sulphur, or 24·52 of sulphuric acid, but only 5·47 of metallic iron, with ·34 of phosphorus, equal to 6·22 of phosphorus to 100 of iron.

These two furnaces used anthracite from the Lehigh region, mixed magnetic and brown hematite ores, and limestones from their respective neighborhoods.

In other samples of the material taken from the flues of different furnaces I have found from about 4 to more than 30 per cent. of the alkalies. Upon searching for phosphoric acid, I never failed to find it; sulphuric acid I also found constantly present and usually in notable quantity.

The material was always, to a large extent, soluble in boiling water, sometimes more than 60 per cent. being dissolved. It was, invariably, readily fusible in the flame of the blow-pipe.

These remarks have reference only to the flue deposits from anthracite furnaces I have no personal experience in the examination of that from coke or charcoal blast furnaces. I should infer, however, that anthracite and coke furnaces afforded deposits of corresponding composition, while charcoal furnaces afforded the material relatively richer in potash and poorer in sulphuric acid.

A sample taken from the flues of a puddling furnace yielded, upon analysis, as given in column II. of above table.

Another sample of deposit, taken from the flues of a boiling furnace, yielded as given in column III.

The two last samples were received from the works of the Phœnix Iron Company. The iron worked in the furnaces was known to be phosphoric. The fuel used was bituminous coal.

The results quoted would seem to show pretty clearly that more or less phosphorus is volatilized from iron during the processes of smelting, puddling, and boiling. They, beyond question, show that the substance is carried with the dust and fumes from the furnaces into the flues and chambers. And as it is known that limestones and coals usually contain very little of it, it may be assumed that much the larger portion of what was found in the deposited matter came from the ores and metal. That all that passed up from the furnaces became deposited in the flues and chambers cannot be supposed.

It is more than probable that no inconsiderable amount escaped along with its associated matter entirely through the works into the open air. The results so far obtained therefore could be of no value in determining the total percent. volatilized, even from all the material in the furnaces, though the weight of that material as well as the weight of the flue deposit were known.

But these results present another matter of no less importance for consideration. They show that there is expelled from the blast furnace a very large amount of alkali. Sixteen, eighteen, and even more than thirty per cent. of the gross flue deposit proved to be potash and soda. The question at once arises, From what source or sources did they come? We know that nearly all iron ores contain a little, but usually not enough for the careful analyst to quantitatively determine. And the same may be said with still more emphasis

* A Paper read before the American Institute of Mining Engineers, at the Philadelphia Meeting, June 23, 1876.

† Equal to 2·67 of phosphorus to 100 of iron.

‡ Equal to 6·03 of phosphorus to 100 of iron.

§ Equal to 4·72 of phosphorus to 100 of iron.

the limestones. We then must look to the fuel as having been the chief source. It has not, I believe, heretofore been shown by the analysis of anthracites that any of them are rich in alkali, indeed mostly just the contrary has been shown, but this may have been due to defect in the method of analysis. Search has been confined to the ash only, and not extended to the raw coal or the total product of combustion. The question undoubtedly is worthy of solution.

As the quantity of such flue deposits is considerable and may be still further increased by alteration of a portion of the works, it is important to consider their practical or commercial value. At present, so far as I know, they are only an object of annoyance and expense by stopping up the flues and chambers and more or less affecting injuriously the hot blast pipes and boilers, and must be periodically removed. The practice is with occasional exception to throw them away. They may be used with much profit for the production of commercial alkali, and also for fertilizing land—as a top dress for grass they would prove much more valuable than ground plaster.

I infer from the examination made that the alkalies will in the main be found in condition as sulphates, silicates, and carbonates, and but to a very limited extent as cyanides or cyanates, and that the composition of the deposit at any one works will be more or less inconstant, and will also vary according to the point at which it forms—thus that which forms in the flues near the furnace will not, by a considerable difference, be the same as that which forms near the exit at the end of the boilers. This would be the supposition from known laws, but the analyses seem to afford proof of it.

EARLY ACCOUNTS OF PETROLEUM IN THE UNITED STATES.

By William J. Buck, Curator of Records, Pennsylvania Historical Society.*

(*Continued from page* 589, vol. xxi.)

OHIO.

IN a communication on the resources of the State of Ohio, written in August, 1808, by GIDEON C. FORSYTH, of Wheeling, and published shortly after in the *New York Medical Repository*, he says "There are many springs where the Petroleum or Seneca oil is gathered in abundance." Under date of January 17th, 1809, to the same publication, Dr. S. P. HILDRETH, of Marietta, in describing the productions of that neighborhood, remarks that "Seneca oil is a kind of Petroleum, is found up the Muskingum. It is obtained when the water is low, in the beds of creeks and the river. It commonly rises in bubbles, which burst and float on the water. Where these are seen to rise, they inclose the place with stones, to prevent the current from carrying it away, and sometimes gather a barrel in a few days."

Dr. HILDRETH, in 1819, wrote a series of articles relating to the geology and topography of Ohio, addressed to his friend CALEB ATWATER, Esq., of Circleville. From these we learn that operations were commenced in the Summer and Autumn of 1817 to bore for salt water on the Little Muskingum, for which purpose two wells were sunk upwards of 400 feet in depth.

"One," he says, "affords a very strong and pure water, but not in great quantity. The other discharged such vast quantities of Petroleum, or, as it is vulgarly called, '*Seneca Oil*,' and besides, is subject to such tremendous explosions of gas as to force out all the water, and afford nothing but gas for several days, that they may make but little or no salt. Nevertheless, the Petroleum affords considerable profit, and is beginning to be in demand for lamps in kshops and manufactories. It affords a clear, brisk light when burnt in this way, and will be a valuable article for lighting the street lamps in the future cities of Ohio."

This remarkable prediction was made more than forty years before the successful attempt of Colonel E. L. DRAKE near Titusville, and at a depth six times greater. WARDEN, in his "Account of the United States," also gives us some information in 1819 respecting the existence of Petroleum in the Valley of the Muskingum and its branches.

WESTERN VIRGINIA.

Although Petroleum has been known to exist in Western Virginia for some time, I have still been able to find but little of interest relating to the subject in that section, compared to what has been given in the neighboring States and New York. General LINCOLN, in his communication to the Rev. JOSEPH WILLARD in 1783 on the oil spring in Pennsylvania, says:

"There is another spring in the western part of Virginia, as extraordinary in its kind as the one just mentioned, called the Burning Spring. It was known a long time to the hunters. They frequently encamped by it for the sake of obtaining good water. Some of them arrived late one night, and after making a fire they took a brand to light them to the spring. On their coming to it some fire dropped from the brand, and in an instant the water was in a flame, and so continued, over which they could roast their meat as soon as by the greatest fire. It was left in this situation, and continued burning for three months without intermission. The fire was extinguished by excluding the air from it, or smothering it. The water taken from it into a vessel will not burn. This shows that the fire is occasioned by nothing more than a vapor that ascends from the waters."

He further informs us that he had received this information chiefly from Gen. Washington, who had become the owner of the land around the spring, from the interest he had taken in it as an object of curiosity. This may be observed also in the notes to the schedule of his will, dated July 9th, 1799; in speaking of his lands upon the Great Kanawha, he says: "That the tract of which the 125 acres is a moiety, was taken up by General ANDREW LEWIS and myself for and on account of a bituminous spring which it contains, of so inflammable a nature as to burn as freely as spirits, and is as nearly difficult to extinguish."

THOMAS JEFFERSON, who wrote his account in 1781, gives some additional information:

"In the lower grounds of the Great Kanawha, seven miles above the mouth of Elk River, and sixty-seven above that of the Kanawha itself, is a hole in the earth of the capacity of thirty or forty gallons, from which issues a bituminous vapor in so strong a current as to give the sand about its orifice the motion which it has in a boiling spring. On presenting a lighted candle or torch within eighteen inches of the hole it flames up in a column of eighteen inches diameter, and of four or five feet in height, which sometimes burns out within twenty minutes, and at other times has been known to continue three days, and then has been still left burning. The flame is unsteady, of the density of that of burning spirits, and smells like burning pit coal."

JOSEPH SCOTT, in his "United States Gazetteer" of 1795, and JOSEPH MARTIN, in the "Virginia Gazetteer" of 1836, have also given notices of this spring.

In the "Account of West Virginia," by J. R. DODGE, we learn that in 1825, oil was procured by digging pits to the depth of a dozen feet or more along Hughes River, below the junction of the North and South Forks. It was chiefly used as a liniment for burns, cuts, and bruises. In these excavations it was obtained by simply pouring in water, stirring the sand with hoes, and allowing the oil to accumulate on the surface. While boring for salt on the Little Kanawha, twenty-seven miles from Parkersburg, in 1842, Petroleum was discovered, but no particular efforts made for obtaining it till in the Fall of 1859.

GENERAL REMARKS.

Petroleum became first introduced as a medicine; of its virtues in this respect sufficient has been given in the numerous extracts quoted. As it is now so much used for giving light, for which purpose it is one of the best and cheapest, I deem that part of its history of particular interest. DAVID ZEISBERGER, who visited the Pennsylvania Oil Region in the Summer of 1767 as a Missionary amongst the Indians, mentions in his manuscripts about the oil springs there, and that the Petroleum "can also be used in lamps. It burns well." This is the earliest mention of this use I have found in our country, and gives also the method adopted in purifying it by boiling in kettles. This statement is confirmed by Bishop Loskiel in his "History of the Indian Missions" published in 1789. Dr. HILDRETH, of Marietta in 1819, in enumerating the advantages of Petroleum, says it "is beginning to be in demand for lamps in workshops and manufactories."

A letter was published in the Pittsburg *Gazette* in 1828, suggesting that said city be lighted at that time by Petroleum:

"I see," says the writer, "that the corporation has at last determined to light the city. It is a very sensible determination; for indeed few places need it more. I fear that lighting with gas will be found troublesome and expensive, in spite of the vast supply and cheapness of coal; but I will tell you what is the cheapest, best, and most economical light you can use; it is what is called in the West Seneca oil, which is Petroleum. This substance, were there a ready market for it, might be supplied at your very doors to an almost unlimited extent. At present it is almost useless, being used only as an ingredient in what is called 'British oil,' and as a horse medicine (in which, by the by, it is very useful). The price of it is very low, because a few barrels glut the demand of the apothecaries; but if the city would take a large quantity, or if it were brought into use otherwise, I think it could be supplied at twenty-five cents per gallon. The salt wells may be cleared of what floats along by letting a blanket down every quarter of an hour, and this will also apply to the springs where it is discovered. Let any one who doubts that it is a perfectly good oil for lamps, send to the apothecary's for half-a-pint, and burn it one night in a lamp of any kind, precisely as fish or spermaceti oils are burned, observing only that to avoid smoke, it is necessary the length of the wick should be diminished. I have tried it, and found it to succeed perfectly, and there is no reason why it should not be clarified as well as any other oil (and then it will burn as free from smoke), by filtering or precipitating the gross particles contained in what is now brought to market. If Seneca oil will supply more gas than animal oils, which I do not doubt, and if it can be procured at twenty-five cents per gallon, a fair trial of it in this way would, assuredly, be demanded by common prudence."

Little did the readers of that article, fifty-eight years ago, expect the facts that were therein set forth to be realized about one-third of a century later. He mentions his mode of burning it, which no doubt was the same way to which GORDON in his Gazetteer had reference in 1832 CHARLES B. TREGO, in 1843, speaks of it as burning "well in lamps, though it emits a heavy black smoke, and a strong bituminous odor, which to many persons is disagreeable."

The discovery of the distillation of oil from cannel or bituminous coal, called kerosene, greatly aided in bringing the natural product into use, by its being already at hand and requiring only the application of the refining and deodorizing processes that had been previously acquired thereby to produce a much cheaper article. With this also came an additional improvement in lamps for burning it. To the cylindrical tube of an inch or two in length was added the glass top or chimney, which caused it to emit a stronger light, cease smoking and to be less easily extinguished in carrying from place to place.

Under the old method of collecting the surface oil from the springs along Oil Creek, General SAMUEL HAYS, who resided since 1803 in that section, estimated the highest annual yield at sixteen barrels, worth at Pittsburg about one dollar per gallon. CHARLES B. TREGO, in 1843, estimated for some time previous the average of each proprietor as producing from two to twelve barrels a year, the amount being greater with low water in a dry season. GORDON, in his Gazetteer, informs us that in 1828 there were five salt wells on the Allegheny that made 7,000 barrels per year; that these wells were generally from 400 to 500 feet deep, and one of 750 feet tubed, with copper and pumped by steam, but had been previously worked by horse-power This is significant, for it shows that in the vicinity of the Oil Region, at least one-third of a century previous to Colonel DRAKE's successful boring, they must have had a good knowledge of the art, and all it needed was to apply it for that particular purpose In corroboration, in boring for salt in 1845, near Tarentum, on the Allegheny River, twenty miles from Pittsburg, abundance of Petroleum was found, similar to what was discovered in 1817 on the Little Muskingum, as related by Dr. HILDRETH. Also, in boring for salt in Western Virginia, a number of Petroleum springs were struck between the years 1825 and 1857, the annual production from 1850 to 1857 being estimated by DODGE to reach seventy-five barrels per annum. Had there been a sufficient demand, the business of production could have thus been made much greater. The wonder is now that it did not come sooner in general demand as a cheaper light, and for the many other useful purposes to which it is applied.

It is very well, in reviewing the past for two and a half centuries, what has been said respecting the discovery and early accounts of the importance and value of Petroleum in our country, also to take some notice of the works that within a recent date have given it little or no attention, and under the circumstances are occasion for surprise. In HAZARD'S "Register of Pennsylvania" for the years 1831 and 1835, may be seen two lengthy descriptions of Venango County, written, it appears, by correspondents residing there, though an account is given of the natural resources, not a word is mentioned therein of Petroleum. In the article Bitumen, in the "American Encyclopedia," published in this City in 1835, mention is made of its being found abundantly in New York, Kentucky, and Ohio, "where it is known under the name of Seneca or Genesee oil." Pennsylvania being omitted in the list. By order of the State and its expense, a geological survey of Pennsylvania was made between the years 1836 and 1857, resulting in the publication in 1858 of what is called the "Geology of Pennsylvania," in two quarto volumes, containing, without the preface, 1,632 pages. In its copious index, Petroleum is referred to *only once*, which is at page 583 of volume I. "A little Petroleum is found in all of those quarries," speaking of

* A Paper read before the Historical Society of Pennsylvania, March 13, 1876.

the building stone in Erie and a portion of Crawford Counties. But we do no better respecting Petroleum when we examine the large map attached to the work, for we find whatever is there noted respecting it is copied from JOHN MELISHS' map of the State published in 1822, and precisely to the same scale. Those engaged on the present geological survey, we have no doubt, will give it that attention which its present importance deserves.

The intention of this paper is purely historical, to bring together, but not without considerable research, the early accounts I have been enabled to find respecting it, which I have thought the interest arising from the subject now demanded ; giving this opinion only after having examined numerous works on Petroleum but deemed deficient in this particular. So the design is to omit the history of its general use and introduction, say for the last quarter of a century, which has been amply treated upon. To show the magnitude of this product we present the following statistics: The total production of crude oil in Pennsylvania in 1872 was 6,539 000 barrels, West Virginia, Kentucky, and Ohio, 325,000, and Canada 530,000 barrels. Thus it will seen for said year that this State produced considerably over seven times more than the rest of the United States and British America together. In the year 1874, 417 vessels were loaded with Petroleum at Philadelphia, of which 51 were American, 11 Austrian, 1 Belgium, 116 British, 6 Danish, 104 German, 1 Holland, 23 Italian, 73 Norwegian, 7 Portuguese, 7 Russian, 4 Spanish, and 23 Swedish, carrying 1,652,601 barrels, valued at $9, 648,063—exceeding for said time the shipment of breadstuffs at the same port almost $1,500,000. The total value of Petroleum exported for that year from the ports of New York, Boston, Philadelphia, and Baltimore was $37,000,000.

CLEAVAGE PLANES AND THEIR INFLUENCE ON THE ECONOMICAL WORKING OF COAL.

THE influence of the cleavage planes on the economical working of coal is eminently a practical subject, and one that claims particular attention at the present time. Probably at no period in the history of coal mining has it been more imperatively necessary to observe the conditions of cheap production than now, and hence a consideration of any question affecting the expenditure of labor, or the market value of the produce must be deemed opportune. The influence of the cleavage planes does not, indeed, constitute one of the great questions of the day, like machine boring and mechanical hewing, for example ; but it has its importance nevertheless, and it is because of its minor character that it is likely to be overlooked. Moreover, there are cases in which its importance is in the highest degree pressing. I have lately remarked that in some of the thin seams in Somersetshire attention to this matter of the cleavage has changed loss into profit, and thus rendered a seam workable which otherwise must have been left as useless.

The influence of the cleavage planes is of a two-fold character, or rather is operated in two directions. In one direction it affects the expenditure of labor; in the other direction it affects the value of the produce. The ultimate object of all the methods and expedients adopted in mining is to obtain the largest possible quantity of coal in the best possible condition at the least possible cost, and as the question under consideration greatly affects the physical condition of the produce of a seam, and the amount of labor expended thereon it is obvious that it bears directly and in an important degree upon the attainment of that object. Regarded from the point of view of production only, the question thus presents itself in a two-fold aspect, relating, on the one hand, to a reduction of the amount of labor required, and, on the other hand, to a reduction of the waste. In treating the question from these two points of view I cannot hope to bring to your notice much, if anything, that is new. The existence of the cleavage planes in coal is no recent discovery, nor has their influence been unknown till now. On the contrary, the subject is one with which all mining engineers are familiar, and to which some have given much attention. Therefore, all I can hope to do is to lay the matter clearly before you so that you may be able to comprehend it perhaps somewhat more fully than casual observation would have enabled you to do. If, by so doing, I succeed in awakening an interest in the subject I shall have attained the end I had in view in choosing it for consideration on the present occasion.

By the cleavage planes in coal we understand that system of divisional planes which traverse the coal vertically, and along which the coal readily divides or cleaves. These planes are commonly known as the "slynes" or "cleat," and they may be regarded as a very perfect example of the joint structure. There are always two sets of these cleavage planes, and the sets are usually at right angles to each other. One set is, however, in every case more fully developed than the other, and along these planes the coal cleaves very readily leaving a smooth surface called the "face." The direction perpendicular to the face, in which the other and less fully developed set of planes run, is called the "end" of the coal. When the development of the latter set is not greatly inferior to that of the former, the coal cleaves or breaks up into cuboidal blocks, and the "ends" exhibit no very distinctive appearance. But when, as in Derbyshire coal fields, for example, one set is very fully and the other very imperfectly developed, the ends assume a decidedly characteristic aspect. In such a case the face is smooth and regular, and the end broken and jagged. Coal with such a cleavage divides readily in one direction, that of the slynes, and with difficulty in the direction perpendicular to that of the slynes, so that the mass breaks up into long prismatic pieces. If, in consequence of the complete development of the two sets of cleavage planes, the coal divides as readily or nearly as readily, in one direction as in that perpendicular to it, obviously it can matter but little whether we work upon the face or the ends, since the labor required and the quality of the produce must be the same in either case, or nearly the same. But when, in consequence of the development of one set of planes, the coal cleaves readily in one direction only, and is very resistant in the other, it is evident that the circumstance will affect both the labor of getting and the physical condition of the coal when got. Between these two extremes there is every gradation, and the influence of the cleavage will increase as it becomes less perfect, in other words, as the face and the ends become more distinct. In order to obtain a clear conception of the subject we will assume the extreme case in which only one set of planes is fully developed, as in some of the Derbyshire coal.

The cleat of coal is a quality superinduced upon the substance by the action of pressure and the shrinking of the mass in drying ; that is, it is a true joint structure. In direction, it is wholly independent of the dip and strike of the seams, and is persistent over large areas. In the whole of the North of England coalfields, for example, the direction is south-east and north-west. It may be changed in places by the occurrence of a fault, but generally it remains the same over a wide extent of country. Hence the direction of the cleat may make any angle with the dip of the beds, and, consequently, with the direction of the workings laid out in accordance with the dip. Thus we may have the workings advancing "on the face," or "the ends," or at any intermediate angle with the cleavage planes. Usually, however, this intermediate angle is chosen at 45° or "half on." It is our business now to consider the influence of the cleavage planes on the labor of getting, and on the value of the produce, when advancing in any one of these three directions. But, before entering upon this consideration, it will be well to direct our attention for a moment to the action of a force applied in a vertical direction to a block of any cleavage substance. Suppose a block, say a stone, in which the cleavage planes run vertically, in other words, standing on end, and a force applied in a vertical direction to its upper surface. As the line of pressure falls within the base, the block will be stable, and, consequently, it can yield only by being crushed. In this crushing, we have two effects ; first, a separation will take place among the laminæ ; that is, the stone will be divided along its lines of cleavage into a number of thin plates ; and second, each of these plates, deprived of the support of its fellows, will be bent and fractured across, and the whole block will fall to pieces. These effects would be clearly seen if the block in question was of slate. Suppose again the block to be inclined to the plane upon which it rests, as the force applied as before. In this case, as the line of pressure falls without the base, the block will be unstable and it will yield by falling over. But suppose it held in position by means of a horizontal cord attached to it. Evidently a portion of the force applied to the upper surface of the block will be exerted upon this cord, that is, the force will be resolved into two components, one of which acts in a vertical direction, and the other in a horizontal direction. Now it will be observed that this horizontal force tends to split the block along its cleavage planes ; for it is plain that the force which tends to break the cord tends also to separate the laminæ or plates of which the block is composed. We saw also in the last example that the vertical force tended to produce the same effect and to fracture the plates when separated. In this second case, therefore, the cleaving effect of the force applied is greater than in the first, and the fracturing effect in an equal degree less, since the vertical force is less by so much as the horizontal force is greater. Again, suppose the block to be resting upon an inclined plane, and the force applied as in the other two preceding cases. Evidently we shall have the same effects as in the case last considered, since the conditions will be the same whether the block only, or both the block and the plane be inclined. But when the plane is inclined, the action of gravity upon the block is added to that of the force applied to its upper surface. This action will tend to cause the block to slide down the plane, and its amount will be that of the weight of the block multiplied by the size of the angle of inclination. Thus, if we suppose the block held in position by a cord parallel to the plane, we shall have a greater force exerted upon the cord than in the last case, and, consequently, a greater tendency to separate the laminæ or plates of which the block is made up, without a corresponding diminution of the fracturing vertical force. Hence in this position, the block will be still less able to resist than in the preceding, which was more unfavorable than the first. If now we suppose, instead of the cord attached to the higher side of the block, a rigid rod applied to the lower side, we shall have the conditions entirely altered, for the resistance offered by the rod will tend to press the laminæ or plates still closer together instead of separating them, as in the former cases, and, consequently, the crushing effect of the force applied will be greatly lessened. Under these conditions, therefore, the block will not be cleaved and fractured by the same force which was sufficient to produce those effects under the former conditions. These are simple matters, doubtless familiar to you all, but a reference to them may serve to render our notions of the influence of the cleavage planes in coal more precise and definite.

Let us now see what the effects of these cleaving and fracturing forces are upon the coal in the seam, and first, let us suppose a flat or horizontal seam. While the seam lies whole in the earth, the pressure of the overlying beds is practically, equal at all points, and the coal is able to resist this pressure, because it is supported on all sides. But when, by the removal of a portion of the coal in opening out workings in the seam, we have altered these conditions, it becomes necessary to determine what the consequences will be of the disturbance made in the balance of forces. You will observe that the removal of a portion of the coal has two important effects ; one is to increase and render unequal the pressure upon that which is left. The weight of the overlying beds which was borne by the coal removed is thrown upon the solid coal remaining in the ground and upon the props and packing beyond the unsupported portion of the roof. This pressure will, however, be divided unequally, the major portion being thrown upon the coal by the yielding of the artificial supports and the consequent bending of the roof. Moreover, another consequence of the descent of the roof over the portion worked out is to throw the additional pressure upon the edge of the whole coal, which serves as a fulcrum to the lever formed by the unsupported roof. Thus it will be seen that by the working away of a portion of the coal, the pressure upon that remaining has been augmented, and that the additional pressure has been applied near the face. The intensity of this pressure will obviously vary with the character of the roof, which may consist of hard, or of soft rock, and which may bend and drop slowly, or break short off, and also with the distance through which the roof falls. The other effect of the removal of a portion of the coal is to leave the remainder unsupported on one side. Now it will be observed that the absence of a support on one side leaves the coal to resist in that direction by the cohesion of its particles alone. Thus we have, by opening out workings in the coal, increased the force acting upon it, and lessened its power of resistance. The mass forming the face of work is now acted upon by the downward pressure only, conditions similar to those of the block in the first example, the only difference being that the block is unsupported upon two opposite sides, while the coal is unsupported upon one side only. Hence while the block can yield in two opposite directions, the coal can yield only in one. In other respects, the effects of the pressure applied to the upper surfaces will be the same. If we suppose the coal to be without any cleat whatever, the pressure upon it will still cleave it up into thin plates or laminæ, which will be afterwards fractured across, as already described. This mode of breaking up is the only one possible, as the pressure acts vertically from above, and as the coal is unsupported upon one side only, it is obvious that it can yield to the pressure only by moving forward in the direction of that side. And if the face move forward, the substance being inelastic, it is equally obvious that a separation of the mass must take place ; this separation will be a vertical line of fracture. But as the pressure is greatest, as we have shown, near the face, and as moreover each particle of matter behind the face is, in some degree, supported by that in front of it, the portions of the mass which are nearest the face will move with the highest velocity. Thus from the face backward we have the particles in each vertical plane moving with diminished velocities,

so that when those in the face have moved forward through a given space, say 6 inches, those which are situate 3 feet back from the face will have moved through only a small fraction of that space, say ¼ inch. Now you will observe that this unequal motion tends to separate each particle from that immediately in contact with it along the line of the motion, so that instead of one line of fracture, we shall get a great number of such lines. But as coal is not a perfectly homogeneous substance, there will exist differences of cohesion among the particles, and hence the number of the lines of fracture will be lessened and the intervals between them will be irregular. What will actually occur will be the breaking up of the mass into numerous plates of unequal thickness, but generally increasing in thickness as they become more distant from the face. These plates will be curved and broken by the pressure upon their ends. This circumstance will cause the face of the coal to bulge in the middle, and when this deformed face is worked upon, the coal will fall in small pieces. The action which I have endeavored to describe and explain may be observed by any one. It is no uncommon thing to find the face of a heading in coal, which had been abandoned for some months, several feet back from the point at which it was left. In some instances, it has been known to have moved forward several yards, and to have forced the timbering before it. Now though while the working is actively carried on there is not time for any perceptible movement to have occurred, yet the movement does go on, and is sufficient to cleave the mass in which it occurs. Thus the first practical result to which these considerations lead us is that when the face is carried briskly forward, the labor required to be expended is greater, and the proportion of small coal made is less than when the operations are carried on slowly.

We have seen that the action of the pressure of the overlying rocks is to cleave the coal, irrespective of any lines or planes of cleavage that may exist in it. Now, it is clearly apparent that if such planes occur, they will greatly modify the effects produced. A cleavage plane is a plane along which the coal divides readily; or, perhaps, to speak more accurately, along which the coal is already divided. For the shrinkage which caused the cleat, separated the substance into plates or laminæ which now adhere to one another. I, therefore, these cleavage planes coincide in direction with the lines of fracture, caused by the downward pressure of the overlying rocks, the effects already described will be greatly intensified, since the mass will be more easily cleaved. In other words, as the coal, under such conditions, offers much less resistance to the pressure upon it, the mass will be cleaved to a greater distance back from the face, and the portion near the face will be more brok n. In consequence of the comparatively small resistance offered by the coal, in such a case, the movement, due to the pressure of the roof, will proceed more rapidly. Whence we conclude, as a second practical result of these considerations, that when the cleavage lanes coincide with the lines of fracture, that is, when the working is on the face, the advance should be more rapid than when the planes do not so coincide in order to obtain, with the same expenditure of labor, the coal in the same condition.

Hitherto, we have assumed the seam to lie horizontally; let us now observe the effects of the pressure, and the influence of the cleavage planes, when the seam is inclined. So long as we work such a seam by level workings, that is, workings which advance along the strike, the conditions do not differ greatly from those encountered in flat seams. But when we proceed in a direction perpendicular to this, the conditions are either modified or altogether altered. In working to the rise, we have the cases of the block described in the second and third examples. It was there shown that the cleaving and fracturing forces were greater than in the case illustrated in the first example, which is that of the flat seam. Also, these forces, which are thus notably increased, are still further augmented by an action of the roof, not observable in flat seams. In consequence of the sagging and fall of the roof over the working places, and the face in long wall workings, that portion which rests upon the coal has a tendency to extend, that is, to be drawn out horizontally. This action of the roof greatly assists the cleaving action of the downward pressure, so that in rise workings the cleaving forces are greatly intensified. Evidently the intensity of these forces will increase, other things being the same, with the degree of inclination. Thus a third conclusion at which we arrive, is that in rise workings, when the cleavage planes coincide with the lines of fracture, the face should be carried forward rapidly, especially if the inclination be great, and the coal weak. It also appears that if the coal be very tender, a large proportion of small will be made in rise workings, advancing across the cleat. If we proceed in the opposite direction, namely, to the dip, we encounter entirely changed conditions. This case is that illustrated in the third example of the block where the latter is supported on the lower side by the rigid rod. The pressure upon the upper face was there shown to be resisted by the rod, the consequence being that the laminæ, of which the block is composed, were pressed together, instead of being forced apart, as in the preceding cases. It will be seen hence that much less cleaving force will be exerted upon the coal in such dip workings, and that, consequently, the same degree of crushing will not occur. We shall still have, however, the same tendency in the coal to be squeezed out, with its consequent cleaving action; but even this will be somewhat lessened in degree. Thus we are led to a fourth conclusion, namely, that in working to the dip the face may be carried forward more slowly than in working to the rise, or level. Furthermore, it appears that when advancing to the dip, economy of labor requires that the advance be made across the cleat, or on the face of the coal.

Having considered the influence of the cleavage planes relatively to the action of the roof, it now remains to examine it relatively to the operations of "falling" the coal. When the coal along the working face has been undercut, or "holed," as it is called, the mass from beneath which the support has been removed, and on each side of which vertical cuts have been made, is held in position solely by the cohesion of its particles, when the working is "on the ends," and by the adhesion of its plates or laminæ, when the working is "on the face." Now, it is obvious that in the latter case the resistance to be overcome will be much less than in the former, and, consequently, the work of breaking down the mass will be much less also. Very frequently, under such conditions, the weight of the mass, assisted by the action of the roof, is sufficient of itself to effect the falling. But the heaviest labor of getting the coal is the undercutting or holing, and upon this labor the influence of the cleavage planes is considerable. In holding across the cleat, the pick penetrates the laminæ, and then, by its wedge-like and lever action, separates them along the cleavage planes. In this way, comparatively large portions are shipped off at each stroke. But in holing on the ends, this cleaving action of the pick does not take place, and as each portion removed has to be detached by being cut or fractured, the labor of holing is considerably increased, If, when the coal has been holed and sheared at the sides, it does not fall of its own weight, it has to be broken down by means of wedges, or by blasting.

It will be seen that when the wedge is used, this instrument will act more efficiently when the working is across the cleat, than when it is upon the ends. In the former case, the pressure of the wedge is disturbed laterally over a wider surface than it is in the latter case. For when the wedge is on the ends, the tendency of the coal to separate along the cleavage planes, prevents a lateral distribution of the pressure. For this reason, a greater number of wedges will be required to break down the whole of the mass, irrespective of the greater resistance offered by the coal. If recourse be had to blasting, the conditions of the case will be similar.

The effects of a shot in any substance which cleaves readily in one direction, and with difficulty in that which is at right angles to it, is worthy of notice. If the rock in which the shot is fired has no cleavage, as granite for example, a conical mass is projected, the angle of whose sides makes about 60° with the base. But, in a rock having a distinct cleavage, the effect of the shot is somewhat different. If the bore-hole be perpendicular to the cleavage planes, the lines of fracture, instead of running straight to the face at a diverging angle of 30°, will take a curved or irregular course, and a larger mass will be projected. Besides this, if the substance be coal, and its lower support removed by undercutting, a vertical fracture will be determined in the plane in which the holing end, and in this way, the whole mass will be thrown down and broken up. But if the bore-hole be parallel to the cleavage planes, the vertical fracture will be less distinctly determined, by reason of the greater and more unequal resistance offered, and the lines of fracture to the face will run more directly to that plane, thereby causing a smaller mass to be dislodged. It must be borne in mind, however, that when the sides are "fast," these sides offer less resistance in the latter case than in the former; for when the bore-hole is parallel to the cleavage planes, the lines of fracture at the sides coincide with the e planes, whereas, they are perpendicular to the planes, when the bore-hole is perpendicular to them. If the bore-hole cross the planes of cleavage obliquely, the lines of fracture to the face will diverge unequally, one following the line of cleavage, the other running nearly as in the case of no cleavage.

Thus we see, that the labor of getting the coal is reduced to a minimum, when the workings advance across the cleavage planes, or on the face, and this is one of the conditions of an economical production. The other condition of quality in the produce, is, however, of equal importance, and we have seen that this quality is best obtained by working on the ends. Hence, to obtain the greatest possible economy in the getting of coal, that is, to obtain the coal in the best possible commercial state, with the least possible expenditure of labor, each of these conditions must be fulfilled by their relative importance in the particular case in question.

The practical results at which we have arrived from these theoretical considerations are briefly these:

1. The more briskly the face is carried forward, the greater will be the expenditure of labor, and the better the quality of the coal in size.
2. When the working is across the cleat, the quality of the produce requires that the face should be carried forward more briskly than when the working is on the ends.
3. When the working is to the rise, the necessity for advancing rapidly is greater than when the working is on the level, and this necessity increases as the angle of the inclination becomes greater.
4. When the working is to the dip, the face may be carried forward more slowly than when the working is in any other direction.
5. The condition of a minimum expenditure of labor is satisfied when the workings advance across the planes of cleavage.

These conclusions are general, and they are true, irrespective of all other conditions. In practice we meet with every gradation of development in the systems of cleavage planes. Thus one set may be but little inferior in development to the other set, and in such a case, it will always be more economical, when not working to the dip, to advance on the ends. Between these extreme cases, the value of the effects due to the forces to which attention has been directed, must be carefully estimated. We also find every gradation of strength in the coal, and every variety of roof. These circumstances, however, only lessen or intensify the effects which we have been considering, without in any way changing their character. The importance of these modifying circumstances must be determined for each individual case, a work that may be easily accomplished when we have a clear conception of the action of the forces in operation. Sometimes it may be desirable to cross the planes of cleavage obliquely, in the manner known as "half on," that is, half on the face and half on the ends. The degree of resistance offered by the coal in such a case will be readily perceived if what we have already considered has been fully understood.

The conclusions at which we have arrived are those led to by a consideration of the influence of the cleavage planes alone. Of course, in practice, other considerations have to be taken into account in determining the directions of the workings, notably the angle of the dip, and its direction relatively to that of the principal cleavage planes. But these matters are foreign to the purpose of the present lecture, which was to consider the influence of the cleavage planes on the economical getting of coal. It remains only to add, as a matter of some practical importance, that in end workings, the coal is more readily and effectually drained of gas than in face workings, by reason of the much larger number of cleavage planes running out to the exposed surface.

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ADMISSIONS FOR THE WEEK ENDING JULY 11, 1876.

Date.		Paying Visitors.	Press, Complimentary, and Exhibitors.	Total Visitors.
Previously reported.....	.....	1,194,966	537,088	1,732,054
July 5.....	49th Day..	51.711	9,062	60,773
" 6.....	50th " ..	46,051	5,989	52,040
" 7.....	51st " ..	33,746	11,053	44,799
" 8.....	52d " ..	23,207	10,817	34,024
" 10.....	53d " ..	19,133	10,526	29,659
" 11.....	54th " ..	26,405	10,513	36,918
Totals.....		1,395,219	595,048	1,990,267

COPPER MINES IN NEWFOUNDLAND.—Cheering intelligence comes from the Newfoundland copper mines worked by Mr. ELLESSHAUSEN, who now employs over 500 men. Fifteen thousand tons of copper ore will be shipped this season, and recent advices show that a copper mine has been struck which is practically inexhaustible. The same enterprising man is working a lead mine at Morton's harbor with success. —*Monetary Times*, Toronto, June 30.

MINING NOTES FROM ARIZONA, COLORADO, AND MONTANA.

ARIZONA.—*The McCrackin Mine.*—A correspondent of the Wallapai *Enterprise*, under date of June 3, thus writes concerning this mine: "This property, which is now legally known as the "Senator" and "Alta Consolidated," is located some thirty miles east of the Colorado River in the southern part of Mohave County, Arizona. The mine was discovered in 1874, and is one of the best developed of any in the Territory. The vein is a spar formation, running nearly due north and south over and through the McCrackin Hill, which has an altitude of about 3,000 feet above the sea level, and of about 2,000 feet above the surrounding valleys below. This great spar mineral vein is different from any I have ever before seen, but is very similar to some of the largest and richest mineral veins of Mexico. Not a particle of quartz has yet been found in the vein, which is yet of unknown width. The greatest depth yet reached is 367 feet in the main shaft, besides which there are several other shafts and winzes sunk to varying depths, in all aggregating between six and seven hundred feet, and all in pay ore. The several tunnels aggregate 1,100 feet in length, of which over 900 feet is in pay ore. The vein has at no one place been worked out from hanging to foot walls in the several tunnels and drifts, yet, by actual measurement, I found the drifts and chambers worked from 25 to 45 feet in pay rock. The ore is divided into two classes—the first, smelting carbonate ore, which is shipped to San Francisco. The four last shipments of this class of ore gave an average of a fraction over $237 per ton. The second class is free milling ore, which is divided into first and second class. The first class is now being worked at the company's mill at Greenwood, some twelve miles distant. This class of ore gives, by assay, as taken from the mine, an average of $94 per ton. The product of the bullion from the mill now shows a saving of 60 per cent. in the working of this ore, or over $56 per ton. The second class of milling ore is reserved for future working when the company shall have erected a new and larger mill, which will be done as soon as the necessary arrangements can be made. This class of ore gives, by assay, as it comes from the mines, $64 per ton, and in working, with a good mill, will most probably yield over $40 per ton in bullion. The bullion product of the mine is very fine, giving an average of 885. Since February 28, last, twenty-one bars of bullion have been run out, which weigh an average of about 90 pounds to the bar. There is now on the dump pile over 4,000 tons of second-class ore, and in the tunnels and chambers at least 1,000 tons of first-class ore ready to be taken out when wanted for the mill. The country around here is barren of water, and that used at the mine for drinking, cooking, and washing is brought from a well three miles distant. The ore is easily mined, and twenty-five men can take out ore to supply a 40-stamp mill continuously for years. Mills for reducing the ores will have to be erected from six to twelve miles distant from the mine. There is wood sufficient to supply a mill for many years within a radius of ten to twenty miles.

COLORADO.—*Miner*, July 1st. *Vice President*—This mine is in Clear Creek Co., on Brown Mountain. It is situated a little below the Roe. Two levels have been run on the lode, one 80, the other 200 feet long, and a shaft is now being sunk below the lower level, in which specimens of ruby and gray copper have been found. Another level has been started 70 feet lower down. We are informed the ores show a streak of ore varying from four to eight inches wide, while in the shaft the pay streak runs from 9 to 18 inches in width. When connection with the upper levels is made through the shaft and lower drift, the working expenses of this mine will be materially diminished, as no hoisting will be required and the ore can be delivered by cars at the level of the creek, where, we understand, jigs or other concentrating machinery will be erected. As the levels are driven west, and depth gained, we expect to hear good reports. Mill runs of ore taken out by the present owners show returns ranging from 125 to 271 ozs. for first-class, and 50 to 114 ozs. for second-class.

The Central City Tunnel.—This is a new enterprise and one of no little importance when considered in the light of the results likely to be achieved from its accomplishment. This tunnel, is to be of the uniform size of 5½ feet wide by 6½ high, and is to be driven through Quartz Hill to the vicinity of Leavenworth Gulch, a distance of about 3,000 feet. Its starting point is in Nevada Gulch, a short distance above the mouth of the Quartz Hill tunnel, and its direction will be 24 deg. 51 min. west of south. Over thirty lodes, more or less developed, lie in its course, including the famous Burroughs, Roderick Dhu, Illinois, and others, where a depth of 500 feet and over will be attained. As the tunnel will thoroughly explore that part of this wonderful depository of wealth, many blind lodes and extensive ore deposits are likely to be met with. These will furnish a large quantity of ore, while for drainage purposes and as an ore outlet for the mines, it will prove of great benefit to both owners and miners generally. This tunnel site was located in November, 1874, by D. G. WILSON and B. O. RUSSELL, two well-known miners of olden time, who have since organized upon it the Central City Tunnel Company. The tunnel is now in 22 feet. The Adeline and Lewis cluster of lodes will be intersected, and the Fortune lode that has yielded so well, and is owned by the company, will be cut at a distance of 720 feet, and 320 feet below the surface.

Georgetown Miner, July 8th.—The *Atlantic Silver Mine* in Clear Creek County recently made some mill runs as follows, 830 lb., 1,001 ounces silver per ton; 1,384 lb., 487 ounces; 10,177 lb., 310 ounces; 337 lb., 708 ounces silver and 67 per cent. lead; 2,385 lb., 645 ounces. The mine is in good condition and the yield steady.

The Boston Silver Mining Company, in Summit County have now a large force of men employed, divided over their mines and different mills. They are at present working Nos. 5 and 7 lodes from the tunnel, and the Comstock from the upper workings. They have a large stock of ore, estimated at 2,000 tons, ready to send down from the miners, and are now actively engaged making preparations for smelting. The concentration works have been running full time, cleaning up the old stock of ore, and will be kept at constant work. The company have leased a mine on Cooper Mountain, carrying large bodies of iron pyrites, which they are m their smelting operations. They are also prepared to buy ores of all grades, containing silver or lead. We anticipate a very successful season's run for them.

The Hall Valley Smelting Works, in Park County, are now running one furnace, very successfully, having finally arrived at the fine point in the treatment of their ores. They roast, desulphurize, and half-slag their ore (which is a composition of galena and gray copper, carried in a gangue of sulphate of baryta,) in a long reverberatory furnace, introducing it at the upper end, where the heat is lowest, gradually working it down to the lower end where the heat is sufficient to half-liquify the mass, and effect certain changes in its composition, which render it more easily handled by the blast furnace. The blast furnace is turning out very nice copper matte and lead bullion, the bullion carrying about 700 ozs. silver per ton. The company expect to have another blast furnace running very shortly, and will make regular shipments of matte and bullion.

MONTANA.—*Butte Miner, June 29.*—*The Parrott Copper Mine*, located at Butte, has a shaft sunk to the depth of nearly 100 feet, showing excellent ore after reaching a point 25 feet below the surface. Within a few feet of the bottom of the shaft, a level has been run west to a distance of 200 feet, and stoping in two or three places commenced; but it is not rapidly pushed, owing to the inability of the parties operating to secure the necessary amount of transportation sufficient to carry away the ore as quickly as it can be brought to the surface. The character of the ore is a sulphide of copper, and increases in richness as depth is obtained. The ore at the bottom of the mine has every indication of being richer than any taken from above. The average of the first-class, out of a lot of 250 tons sold, is 39 per cent. Upon the dump lies a thousand tons of second-class ore, which will average about 20 per cent. This is too low a grade to be shipped to the States, but as the concentrators now building become completed, this ore will be concentrated, and so made profitable for shipment. The immense quantity of ore now exposed to sight in this mine, and which can be readily extracted, and the limited amount of transportation offering will probably deter the proprietors from sinking to a greater depth than that already attained, before another season opens.

The Banker Silver Lode is situated two hundred yards north of Butte City, and embraces 1,500 feet in an easterly and westerly direction, and 500 feet in surface width. At the discovery stake, the Banker carries a width of about two feet of ore, and a four-feet crevice. Fifty feet further west a working shaft is sunk and well timbered 60 feet deep, at which point water comes in slowly. At or near, the bottom of the shaft a level is run 100 feet easterly, and 100 feet westerly, making 200 feet of level. In this development the ore nowhere "pinches out," but constantly varies in width—the extreme minimum and maximum variation approximating six inches to two feet. It has been observed that the richest ore is found in the widest portions of the vein. The walls are granite, well-defined, though often irregular and plastered with a clayey selvage. Some stoping has been done ascending from the level, and about 180 tons of ore raised from the mine. The first dump sample assayed $384 silver, and $31 gold. About 15 tons reduced, contained, per ton, by battery sample, silver, $181.84; gold, $16.05. A dump sample of about eight tons, assayed, containing, silver, $220.50; gold, $45.14 per ton. These assays were from unassorted ore, taken from the working shaft, including the entire quartz vein In the level the ore is leaner, so far as developed. Fifty tons worked at the mill—some of it second-class and mixed with granite—assayed, by battery sample, from $80 to $125 per ton. The lowest milling returns have been about $60 per ton. Two hundred feet east of the working shaft on the Banker, an air shaft is sunk to a depth of 60 feet, with which the level east will connect when driven 100 feet further. The air shaft exposes a fine quality of ore, which, like that of the working shaft, is a sulphide of silver, blending alternately with the quartz and carrying only traces of deleterious bases. No barren quartz has been taken out so far; choice pieces frequently assay $800 to $1,000 per ton. The Banker claim has, within its boundaries, six distinct lodes, all carrying silver. Many of them, doubtless, unite at a greater depth. The lode worked dips south, making an angle of about 80 degrees with the horizon. It was discovered and located by W. EGBERT SMITH, July 14, 1875. It is flanked on the east by the Clear Grit Lode; on the west by the Oro Butte; both the latter are strong leads, and show excellent surface prospects.

OIL PIPE LINES.—The total mileage of iron pipe used in the oil region is placed by good authority at not far from 1,500 miles, some asserting 2,000 miles to be nearer the truth. This is owned by the following pipe line companies: Atlantic, Union, Keystone, Antwerp, Relief, Sandy and Milton, United, Grant, Pennsylvania Transportation, American Transfer and Conduit. The principal area of these pipes lies in Butler County, where the producing districts are far apart, and the farms in some places are covered as by huge spider webs. The Conduit Company has over one hundred miles in use, including forty-eight miles of main pipe three inches in diameter, and forty-eight miles of "connections," of two-inch pipe. Before a gallon of oil was pumped, this line cost $400,000. Taking 1,500 miles of the quantity of pipe in use, and the cost and laying to be thirty-five cents per foot, it appears that $2,682,000 is invested in pipes alone. The cost of pumps, tanks, etc., will swell this to double the amount.—*Chicago Railway Review*, July 1st.

STATISTICS OF COAL PRODUCTION.

This is the only Report published that gives full and accurate returns of the production of our Anthracite mines.

Comparative Statement for the week ending July 8.

Tons of 2,240 lb.	1876.		1875.	
	Week.	Year.*	Week.	Year.*
Wyoming Region.				
D. and H. Canal Co	—	920,256	48,161	1,650,520
D. L. and W. RR. Co	22,024	651,512	60,916	1,580,425
Penn. Coal Co	12,406	448,328	24,447	659,348
L. V. RR. Co	8,371	440,343	20,860	427,686
P. and N. Y. RR. Co	93	12,649	2,338	59,052
C. RR. of N. J	5,854	556,368	40,086	330,441
Penn. Canal	9,816	146,477	9,248	19,338
	58,564	3,175,943	206,056	4,726,810
Lehigh Region.				
L. V. RR. Co	28,479	1,095,422	31,096	248,169
C. RR. of N. J	11,878	542,996	13,436	32,216
D. H. and W. B. RR	339	18,486	549	33,125
	40,696	1,656,904	45,081	313,510
Schuylkill Region.				
P. and R. R. RR. Co	3,105	1,909,096	136,334	1,001,212
Shamokin & Lykens Val.	12,198	397,641	2,694	574,454
	15,303	2,306,737	162,028	1,575,665
Sullivan Region.				
Sul. and Erie RR. Co	48	26,399	—	5,557
Total	114,611	7,165,983	413,165	6,621,543
Increase	—	544,440	—	—
Decrease	298,554	—	—	—

* Year beginning January 1st.

The above table does not include the amount of coal consumed and sold at the mines, which is about seven per cent. of the whole production.

Perth Amboy business:

	Tons.
Received for the week	4,815
Shipped for the week	12,076
On hand July 8	79,421

Freights to Boston, 90c.; Hartford, 85c.; New York, 40c.

The decrease of shipments of Cumberland Coal over the Cumberland Branch, and Cumberland and Piedmont Railroads amounts to 311,279 tons, as compared with the corresponding period in 1875.

Belvidere Delaware RR. report.

	Week.	Year 1876.	Year 1875.
Receipts of coal at Coal Port (Trenton)	4,796	105,716	2,698
" " " South Amboy	4,652	208,618	24,439
Shipments at Coal Port (Trenton)	7,957	102,978	196
" South Amboy	11,353	215,358	99,576

Receipts of Coal at Boston, for week ending July 7, and years from September 1st, 1874 and 1875.

From	Week. Tons.	Previously. 1876. Tons.	1875. Tons.
Alexandria and Georgetown	—	71,524	84,504
Philadelphia	8,811	542,075	351,417
Baltimore	7,232	117,734	145,398
Other places	5,863	252,899	207,073
Great Britain	110	4,510	2,224
Nova Scotia	467	18,022	21,540

Shipments of Coal from Richmond, from January 1, 1876, to July 8, 1876, inclusive:

	Week.	Year.
By Cannelton Coal Company	874	16,440
" Peytona " "	407	8,065
" Blacksburg " "	402	4,587
" Coal Valley " "	820	6,763
" Other " "	420	4,735
Total tons	2,923	40,590

Coal Shipped at Pictou, N. S., for week ending July 8 1876 ..... 7,436 tons.
Previously exported ..... 55,117 "
Total to date 62,553

The Production of Bituminous Coal for the week ending July 8, was as follows:

Tons of 2,000 lb., except where otherwise designated.

Cumberland Region, Md.	Week. Tons.	Year. Tons.
Tons of 2,240 lb	33,463	818,797
Barclay Region, Pa.		
Barclay RR., tons of 2240 lb	5,689	166,845
Broad Top Region, Pa.		
Huntingdon and Broad Top RR	2,219	81,303
*East Broad Top	1,436	36 202
Clearfield Region, Pa.		
*Snow Shoe	919	29,197
*Tyrone and Clearfield	24,160	568,164
Allegheny Region, Pa.		
*Pennsylvania RR	5,102	105,103
Pittsburgh Region, Pa.		
*West Penn. RR	3,155	101,402
*Southwest Penn. RR	1,229	29,924
*Penn. & Westmoreland gas coal, Pa. RR.	7,768	378,930
*Pennsylvania RR	5,808	155,939

* For the week ending June 28.

The Production of Coke for the week ending June 28.

Tons of 2000 lb.	Week. Tons.	Year. Tons.
Tyrone and Clearfield	..	..
Alleghany Region	..	..
West Penn. RR	732	23,179
Southwest Penn. RR	10,474	243,432
Penn. & Westmoreland Region, Penn. RR.	1,105	22,110
Pittsburgh, Penn. RR	3,048	97,113
Total	15,359	385,834

COAL TRADE REVIEW.

NEW YORK, FRIDAY EVENING, July 14, 1876.

Anthracite.

SOME dealers report an improved demand for coal, especially for Egg and Broken sizes, while others, however, say that trade could not be much worse. A very few who are not informed as to the instability of prices, are placing orders with the belief that they will have to pay an additional 15c. per ton in August; but others, knowing that circular prices are but little observed, and believing that they can buy just as cheaply in the future, are only supplying their immediate requirements.

That the Combination is likely to exist during the balance of the year is generally admitted but its powers to either regulate prices or production are certainly limited. Those of the large carrying companies that are also large miners of coal, undoubtedly observe, to a very great degree, the rulings of this organization, but it is quite evident that the small mining companies, the Pennsylvania Railroad, and the Lehigh Valley Railroad, are paying but slight observance to them.

The production of the small mining companies, on all the roads excepting the Lehigh Valley Railroad and Pennsylvania Railroad, is curtailed to meet the allotments of the Combination, but it appears impossible to regulate their prices. The Pennsylvania Railroad is not at all ruled by the Combination, and it is now said that the Lehigh Valley Railroad has again exceeded its quota of shipments, and this, undoubtedly, has been an important matter of consideration at a meeting of the Combination, which was to have taken place in Pennsylvania last night. Although it was supposed that a total stoppage of mining was to have taken place last week, yet it will be observed, in our regular table, that the production was over 114,000 tons, or more than one-fourth as great as during the previous week. Of this amount the Lehigh Valley Railroad produced 28,479 tons, or one-fourth. The inability of the Combination to regulate trade at present and in the past, is one great cause of the hand-to-mouth policy adopted by a large class of buyers, who believe that the future will show no greater stability in prices.

Our regular production table shows an increase in the production of anthracite coal since January 1, as compared with the like period of 1875, of 544,440 tons. A year ago the six month's strike had but fairly terminated and mining had just been resumed on a large scale, and was continued without interruption until December 1, showing an average weekly production of over 550,000 tons, a quantity only reached during one week this year—the average so far having been but 265,000 tons. The average for the balance of the year will likely be greater, but it will probably be but a few weeks till the production of this year will be no greater than that of last year. A year ago there were no stocks and coal was in large demand, while now, every stocking place of the mining companies is full or nearly so, showing that although the quantity mined has been larger than last year that the quantity marketed has been much less.

Bituminous.

There has been no improvement in the demand for either Cumberland or Clearfield coals. A more liberal supply of vessels at lower rates of freights have had a beneficial effect upon shipments from Georgetown; which, however, has been more than counterbalanced by a sale in Baltimore of some thousands of tons of Messrs. BIRWIND & WHITE'S "Eureka" coal. This coal has appeared so prominently in superseding Cumberland during the last two years, that its good qualities must be fully acknowledged by a large number of consumers, and the Cumberland Companies cannot do otherwise than acknowledge a worthy competitor. The introduction of Clearfield coals into the enemy's camp (Baltimore) is by no means a new feature, but has been going on for two years until the quantity of this coal already received there makes a very respectable amount.

The shipments of Cumberland coal last week show a falling off of about 20,000 tons as compared with the corresponding week of 1875, and a decrease since January 1, as compared with the like period of last year of 311,279 tons. The Clearfield region shows a loss last week of but 181 tons as compared with the corresponding week of 1875, and a gain since January 1, as compared with the like period of last year of 141,322 tons. A year ago a strike of several months duration had terminated, but a short time before, and the companies had a large supply of orders, while now, with an increased capacity, some of the companies complain of dull business. The progress that this region has made during this year and in the face of the great depression in manufacturing would be considered remarkable were it not that it had at its back the policy of the management of the Pennsylvania Railroad which comprehends the requirements of trade, to wit, a cheap fuel.

Coal Trade of Philadelphia.

PHILADELPHIA, July 13, 1876.

The trade continues to be lifeless. The dealers are even holding back the few orders they have to spare their horses during this prostrating hot spell. This is a working week or so called, and a miserable pittance of cars is allowed to the collieries. Whether the cars are actually scarce or made so, the effect is the same. Coal is being delivered now to dealers which was shipped in June. It used to be far better during the old times, when it was hauled by horses over the laterals to reach the canal or railroad.

Freights continue low and depressed. The large amount of ice needed here brings a constant supply of vessels.

** Wholesale Prices of Anthracite Coal for July, f.o.b. at the Tide Water Shipping Ports per ton of 2240 lb.*

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
Wyoming Coals.						
‡Lackawanna and Scranton at Hoboken and Weehawken	4 75	4 85	4 95	5 05	5 65	4 95
Pittston at Newburg	4 60	4 70	4 80	4 90	5 50	4 80
Wilkesbarre at Port Johnston	4 75	4 85	4 95	5 05	5 65	4 85
Plymouth, R. A.	....	....	4 95	5 15	5 75	4 95
Susque. Coal Co. at Amboy W.A.	4 75	4 85	4 95	5 15	5 65	4 95
Kingston at Hoboken	4 75	4 85	4 95	5 15	5 65	4 95
Lehigh Coals.						
Old Company at Port Johnston	5 25	....	5 05	5 05	5 65	4 95
Old Company's Room Run "	5 25	....	5 05	5 05	5 65	4 95
Sugar Loaf, Hobok. & Amb. "	5 25	....	5 05	5 05	5 65	4 95
Lehigh Coal Exchange "	5 25	....	5 05	5 05	5 65	4 95
Honey Brook Lehigh	5 25	....	5 05	5 05	5 65	4 95
Beaver Meadow at South Amboy	5 25	....	5 05	5 05	5 65	4 95
Schuylkill Coals at North 9th st., Brooklyn, E. D.†						
Schuylkill white ash	4 75	4 85	4 95	5 05	5 65	4 85
Schuylkill red ash	...	....	...	5 15	5 75	4 85
Shamokin white and red ash	....	....	....	5 25	5 75	4 85
Lorberry	....	....	5 85	5 85	5 85	4 90
Lykens Valley	....	....	6 30	6 30	6 30	5 35

* Contractor's prices are 20c. per ton less.

†The prices of Schuylkill coals for shipment from Philadelphia are 35c. per ton less than at Brooklyn.

‡ Boats towed by the D. & H. C. Co. at its expense to and from New York harbor.

	Per ton.
Freight from Hoboken and Weehawken to New York	40c
" " Elizabethport & Port Johnston to N. York	40c
" " South Amboy to New York	30@35c

Freight by the boats of the companies from Hoboken, Port Johnston, Weehawken, Rondout, South Amboy and Perth Amboy to New York City and vicinity 50c.

Freight by the Pennsylvania Coal Company's boats from Newburg to New York 65c.

Retail Prices in New York.

Anthracite.

Per 2000 lb.	Grate and Egg.	Stove.	Chestnut
Pittston coal, in yard	$5 70	$6 00	$5 30
Lackawanna coal, in yard	5 70	6 00	5 30
Wilkes-Barre, delivered	6 25	6 75	5 75
Lehigh & Locust Mountain, del'd	7 00	7 00	6 00
Schuylkill Red Ash, del'd	7 50	7 50	6 00

The Cost of delivery for Pittston and Lackawanna coal ranges from 40 cts. to $1 10 per ton, according to distance from the yard.

Bituminous.

Liverpool House Orrel, delivered, per ton of 2000 lb	$18 00
Liverpool House Cannel " " "	22 00
American " " " "	13 00
Cannelton splint, " " "	8 0
Cannelton Block, " " "	8 00
American Orrel " " "	11@14
Red Bank Cannel " " "	14 00
Cumberland " " "	7 00

Wholesale Prices of Bituminous Coal.

Domestic Gas Coals.

Per ton of 2240 lb.	At the Shipping Ports.	Alongside in New York.
Westmoreland and Penn. at Greenwich, Philadelphia	$4 70	$6 00
" " at S. Amboy	5 50	6 00
Red Bank Cannel Pa. at Philadelphia	8 00	8 50
" " South Amboy	8 50	....
" Orrel	6 00	6 50
Youghiogheny, Waverly Co., at Balt.	4 25	5 75
Despard, West Va.	4 50	6 00
Murphy Run, West Va., at Baltimore	4 50	6 00
Fairmount, West Va., " "	4 35	6 00
Newburgh Orrel, Md. " "	4 50	6 00
Cannelton Cannel, W. Va.	....	10 00
" Splint, " at Richmond.	4 50	6 00
" Gas Coal at Richmond	4 00	5 50
Peytons Cannel, W. Va. at Richmond	8 50	10 00

Manufacturing and Steam Coals.

Cumberland, at Georgetown and Alexandria, Va.	3 50@3 75	4 90
Cumberland, at Baltimore	3 65@3 80	5 10
Clearfield f.o.b. Canton, Baltimore	3 75@....	5 25

Rockhill Semi-Bituminous and Broad Top, at the mine, per 2,000 lb., 95, f. o. b. Greenwich, Philadelphia, per 2240 lb., $3 60@3 95, according to destination; at South Amboy, N.J., 4 60; New York, 5 00.

Clearfield and Allegheny, "Kittanning," "Sterling," "Sonman," and "Eureka," at the mines, per 2000 lb., 95; at Greenwich, Phil., per 2240 lb., 3 75@4 25, according to destination; f.o.b. South Amboy, N. J., 4 75; New York, 5 25.

Foreign Gas Coals.

	Sterling.	Am. cur'cy.
Newcastle, at Newcastle-on-Tyne	9/6@11/	6 50@ 7 00
Liverpool House Orrel, at Liverpool	26/	13 00
Ince Hall Cannel "	42/	18 00
" Gas Cannel "	28/	13@14
Scotch Gas Cannel, at Glasgow, nominal,	25/	7 50
	Gold.	
Block House, at Cow Bay, N. S.	2 00	4 75
Caledonia, at Port Caledonia	1 50	4 25
Glace Bay, at Glace Bay	1 50	4 25
Lingan, at Lingan Bay	1 75	....
Sydney, International and Reserve mines, at Sydney	2 00	5 50
Pictou, Albion & Vale mines, at Pictou.	2 25	5 75

Baltimore, Md. July 13, 1876.

Reported by our Special Correspondent.

ANTHRACITE.

Wholesale or Trade Prices per 2240 lb.

Wilkes-Barre "Lee" or "Diamond," Pittston and Plymouth. White ash.	In cars at depot.	By boats afloat.
Lump and steamboat	$4 72	$4 57
Broken	5 10	4 95
Egg	5 20	5 05
Stove	5 61	5 46
Nut	4 76	4 61
Shamokin, (red or white ash), and "Boston," free burning white ash,		
Egg	5 30	5 10
Stove	5 60	5 40
Lykens Valley, red ash,		
Egg and stove	6 15	5 78

From wharf or yard, wholesale, 50@75c. additional.

By retail, all kinds and sizes, per 2240 lb. $6 35@8 00

BITUMINOUS.

George's Creek, Cumberland f. o. b. at Locust Point 3 80@4 00

West Virginia Gas f. o. b. at Locust Point

Youghiogheny Gas, f. o. b. at Locust Point

Boston. July 8, 1876

COAL continues to be dull and languid. The stock held here is quite small, but still there seems to be no disposition on anybody's part to increase. The lack of confidence in the maintenance of prices in either anthracite or bituminous is again very prominent. There are fewer cargoes offering here on the spot and such as are have a hard time to find a cash buyer. There is no change in freights, which are certainly low enough.—*Commercial Bulletin.*

Buffalo, N. Y. July 13, 1876.

Reported by our Special Correspondent.

Deliv'red at	Elmira	Ithaca.	Syracuse	Rochester.		Oswego
	Afloat.	Afloat.	Afloat.	Afloat	ret. del.	f.o.b.
Grate	$4 05	$4 35	$4 50	$5 20	$6 45	$5 45
Egg	4 05	4 35	4 50	5 20	6 45	5 45
Stove	4 45	4 80	4 95	5 65	6 90	5 90
Nut	4 15	4 50	4 65	5 35	6 60	5 60

Delivered at	Erie.	Buffalo.		
	f.o.b.	Afloat.	f.o.b.	ret. del.
Grate	$5 95	$5 45	$5 95	$6 70
Egg	5 95	5 45	5 95	6 70
Stove	6 40	5 90	6 40	7 15
Nut	6 10	5 60	6 10	6 80

Cleveland, O. July 13, 1876.

Specially reported by Messrs. BATES & MARTIN.

Herewith find quotations of our market:

Per ton of 2000 lb. f. o. b. vessels.

WHOLESALE.

	For vessels,	On cars.
Youghiogheny Gas Coal	$4 10	$4 00
Cannel	4 25	4 15
Blossburgh	$5 00	$5 00
Briar Hill, Block Coal	3 50	3 25
Straitsville Coal Co., lower vein	3 00	2 90
" " " whole "	2 90	2 80
Hocking Valley	2 90	2 90
Massillon	3 00	3 00
Tuscarawas Valley	2 65	2 60
Columbiana	2 65	2 60

Office of CLEVELAND COAL EXCHANGE,
89 Seneca Street, June 3d, 1876.

PRICES TILL FURTHER NOTICE.

	1 to 10 tons.	10 tons upw'd.
Massillon, Brier Hill and Mineral Ridge, lump.	$4 50	$4 25
" " " " " nut	4 00	3 75
Straitsville Lower Vein, Hocking & Shawnee, l'p.	4 00	3 75
" " " nut	3 50	3 25
Del Carbo and Rich Hill, lump	3 75	3 50
" " " nut	3 25	3 00
Maple Hill, lump	3 50	3 25
" " nut	3 25	3 00
Columbiana, lump	3 25	3 00
" " nut	2 75	2 50
Lackawanna and Wilkesbarre, egg and grate	7 50	7 30
" " stove	8 00	7 75
" " chestnut	7 75	7 50

No Anthracite coal to be sold for future delivery except it be subject to Exchange price at time of delivery.

H. E. CHUBB, Secretary.

Chicago, Ill. July 11, 1876.

Coal is arriving quite freely, but there is very little selling. Prices remain unchanged.

Cincinnati, O. July 13, 1876.

Reported by our Special Correspondent.

We have no arrivals of Pittsburg coal to report during the month of June, there not being sufficient water for shipment.

Consumption for the month of June was, 134 barges, 1,608,000 bushels. Average price of coal during the month was for

Nos. 1 and 2 Pool	8 cents.
No. 3 "	7¼ "
" 4 "	7 "
Nut Coal	6 "

Coal in first hands is being held firm and at higher prices, viz., 8½ and 9c., as to quality. The demand is

very limited; retail trade very much depressed, consequently not much demand at wholesale.

It is admitted by all that this is the time of year to lay in the supply of coal for family purposes. But the stringency of the money market, and so many men out of employment, deprives this class from getting their fuel at reasonable prices. The wholesale trade, heretofore has, with but few exceptions, been conducted on long time. The failure of several prominent dealers here has put a quietus on this principle, and the producers, while they are in a position to do so, are endeavoring to inaugurate the cash system, or so discriminate between purchasers of undoubted responsibility, thereby placing the business on a *firmer basis* and one of more security to the shipper. The business of shipping coal by river from Pittsburg to Cincinnati, and ports below, is (taking into consideration the numerous bridge piers that obstruct navigation, dams, low water, etc., etc.) among the most venturesome of legitimate commercial pursuits in this country! Although considered by many that "*there is millions in it*," still there has been in the history of the trade from its origin very few men who *died wealthy*. There are at present some very wealthy men and firms engaged in shipping coal, and they have so perfected the system of navigation, using every modern and scientific appliance, that many firms have operated for years without an accident happening to their fleets or losing a lump of coal. This, though, is the exception, not the rule. Runners of coal, years ago, when floating coal in *Broadhorns*, as was their custom, considered if they got but one boat out of the pair safely into market they were fortunate, and could make money. But now the trade is so overdone, and the margin so small, that if a lump is lost it is so much never to be recovered.

Erie, Pa. July 13, 1876.

Wholesale, per ton of 2000 lb. Bituminous f. o. b.

Briar Hill lump	$3 75	Beaver lump	$3 50
Midway	3 25	Cat Fish	3 00

Indianapolis, Ind. July 13, 1876.

Specially reported by Messrs. COBB & BRANHAM.

Wholesale on board cars, and retail delivered to consumers. Per ton of 2000 lb., bushel of 70 lb.

BITUMINOUS.

White River, per ton	$2 50	Peytona cannel, per ton	5 75
Brazil Block, "	2 50	Indiana Cannel	4 50
Highland, grate, "	2 25	Hocking Valley	4 25
Block coal, nut, per car	18 00	Youghiogheny	4 50
Highland " "	18 00	Blossburg (smithing)	6 50
Block Slack "	17 00	Piedmont "	6 50
		Gas coke, per bushel	10

ANTHRACITE (Lackawanna and Wilkes-Barre.)

Broken	$8 35	Nut	8 50
Egg	8 35	Stove	8 75

Lehigh Anthracite.

Broken	9 75	Nut	9 50
Egg	9 75	Stove	10 00

Retail, per bushel, delivered.

Sand Creek	15c.	Block Nut, steam	8
White River	13	" Slack, "	7
Brazil Block	14	Peytona Cannel	28
Highland grate	13	Virginia "	27
Block Nut, domestic use	12	Youghiogheny	20
Highland Nut, " "	12	Blossburg	26
" " steam	8	Piedmont	26

GAS COKE (measured.)

Crushed	15c.	Lump	12c.

ANTHRACITE.

Wilkes-Barre and Lackawanna (all sizes)	$9 75 per ton,
Lehigh, retail	$11 50 per ton.

Louisville, Ky. July 13, 1876.

Specially reported by Messrs. BYRNE & SPEED.

Please report our prices as follows:

WHOLESALE.

	per bushel		per bushel
Pittsburgh	12c.	Pine Hill	—
Raymond City	9c.	Kentucky	8c.

RETAIL.

	per bushel		per bushel
Pittsburgh	12c.	Peytona Cannel	20@22c.
Raymond City	11c.	Buckeye "	20c.
Pine Hill	13c.	City-made Coke	10c.
Kentucky	10c.	Anth., per ton, $10 00 to 10 50	
Screened ittsburgh per load			$3 00
Screened Raymond City			2 75
Pine Hill (Kentucky)			2 75
Cannel			$5 to 5 50

Milwaukee, Wis. July 13, 1876.

Specially reported by Messrs. R. P. ELMORE & Co.

Retail price per ton of 2000 lb.

Lehigh Lump	$10 00	Briar Hill, select	$8 00
Lehigh Prepared	11 00	Blossburgh	8 00
Lackawanna (all sizes)	10 00	Cannel	8 00
Pittston	10 00	Pittsburgh	7 00
Scranton	10 00	Steam coal	7 00

New Orleans, La. July 8, 1876.

Reported by C. A. MILTENBERGER & Co.

We quote:

Pittsburgh coal, retail, per bbl	
" wholesale	30c
" steamboats, per box	40c.
" to manufacturers, per bbl	45c.
" shipments, per hhd	$5 25
Anthracite, wholesale, per ton	
" retail, "	12 00
Virginia Cannel, per bbl	80c.
Scotch " "	80c.
Mt. Carbon, wholesale, per bbl	
" " retail, "	50c.
St. Bernard wholesale, per bbl	30c.
" retail, "	50c.

Pittsburg. July 12, 1876.

COAL.—This important interest continues quiet, and presents but little that is new or important; we need not look for any activity as long as navigation continues suspended, and operators generally in view of the markets accessible by river being overstocked, don't want any water until late up in the Fall, as there is no chance to get up prices until stocks have been materially reduced. At present what little business there is is not very satisfactory, as prices are down to a point that afford little or no margin, and the consumption is always light during the Summer season.

COKE.—There is, so far as we can learn, nothing new to report: business continues dull, as it must in sympathy with pig iron; we cannot reasonably look for any improvement as long as there are so many idle pig iron furnaces. The combination project is still in progress, and from all that we learn promises to be a success; the chief object, as stated in a former report, is to have a uniform price, one that will afford a fair margin for profit, and to regulate production; also, if possible, to obtain more equitable freights, by rail, to the West. Fifty dollars per car to Chicago, it is deemed, is out of all reason, as compared with the through rates from Chicago eastward. We continue to quote Connellsville at $2 40@2.50 per ton, delivered free on cars in Pittsburg. *American Manufacturer.*

Richmond, Va. July 10, 1876.

Specially reported by S. H. HAWES, Dealer in Coal.

Prices are now as follows:

Per ton of 2240 lb., f.o.b.

Kanawha Cannel	$9 00	New River Bituminous,	$4 00
" semi-Cannel	4 00	Clover Hill Coal	3 50
Coalburgh Splint	4 00	James River bitum	3 30
Lewiston "	4 00	" " Carbonite,	5 00
Kanawha Gas coal	3 90		

Montreal. July 10, 1876.

Specially reported by Messrs. ROBERT C. ADAMS & Co.

Wholesale per ton of 2240 lb.

Scotch Steam	$4 60	Cape Breton Steam	$4 00
Pictou "	4 50	Newcastle Smiths	5 50

Anthracite at retail, per 2000 lb., delivered.

Egg	$6 70	Chestnut	6 40
Stove	7 15		

Toronto, Ont. July 10, 1876.

Chestnut	$7 25
Stove	7 50
Egg and grate	7 25
Bituminous coal for domestic use	6 00
" " steam	3 50@5 50
Lehigh Lump and broken	7 50
Blossburgh	6 50

Rates of Transportation on Anthracite Coal to Tide Ports.

Lehigh and Wyoming Coals. per ton of 2240 lb.	From Penn Haven.	From Mauch Chunk.	From Hazleton**	From Upper Lehigh.	From Ashley and Sugar Notch.
To ‡ Newark, N. J. (117 miles), via Central Railroad of New Jersey	2 36	2 22	2 78	2 69	2 92
‡ Mauch Chunk, Pa., via Central Railroad of N. J.	14	..	56	47	70
‡ Philipsburg, N. J., (46 miles)	89	75	1 31	1 22	1 45
Elizabethp't, (114 m) Pt. Johns., Hoboken & South Amboy, N. J., shipping and wharfage 35c. add.	2 00	1 86	2 42	2 33	2 56
High Bridge, N. J.	2 40	1 95	2 80	2 54	2 72
Elizabeth, Cranford, Westfield & Elizabethport, for consumption,	2 36	2 22	2 69	2 69	2 92
Jersey City, N. J., (121 miles) and New York, via L. V. RR.	2 30	2 16	2 63	2 63	2 86
Andover, via Delaware, Lackawanna and Western RR.	3 30	3 10	3 70	3 69	3 99
§ Trenton Somerset Junction and Greensburg, via P. RR. Belvidere Division	2 65	2 45	3 05	3 04	3 34
Trenton, (97 m.) for shipment, including shipping and wharfage	2 11	1 95	2 45	2 46	2 76

From *Mauch Chunk* to *New York* (121 miles), (towing limits) and Jersey City† via Lehigh Valley RR. $2 14

From *Mauch Chunk* to *Philadelphia* (93 m.) via L. V. and L. and S. RR. and North Penn. RR 1 75

††From *Phillipsburg, N. J.* to *Hoboken* (84 m.) for shipment via Delaware. Lackawanna and Western RR., Morris and Essex Division 1 10

From *Lackawanna Junction* to *Auburn, N. Y.*, (191 m.) for shipment, via Southern Central R.R. in connection with Pa. and N. Y. R.R. 2 41

From *Lackawanna Junction* to ‖ *Weedsport* (201 m.), for *Rochester and Charlotte and Erie Canal* 2 47

From *Lackawanna Junction* to *Sterling* for *Oswego, N.Y.* 2 50

‖ To this point for all places between Rochester and Buffalo the rate is 2 52

* The rate to this point for Syracuse is 2 08

** Rates on line coal from Hazleton are 10c. per ton above these figures.

‡ The cost of unloading is to be added to these rates. No charge less than 40c. per ton will be made for any distance. Tolls from Mauch Chunk to Phillipsburg for way points will be $1 15 per ton.

§ Twenty cents per ton less when five cars at a time to one party. Provided that where the reduction makes the rate $1 a ton, or less, the rate will be $1.

† Transportation on Coal destined for re-shipment from this point is 20c. less than above rate.

†† The rate for consumption to this point is $1 80.

The distances in the above table are Computed from *Mauch Chunk*. From *Ashley* to *Mauch Chunk* the distance is 51 miles, and from *upper Lehigh*, 33 miles. From *Hazleton* 24 miles, and from *Penn Haven* 8 miles.

From *Wilkes-Barre* to *Perth Amboy* via the Lehigh Valley Railroad Company, the distance is 161 miles, and from *Mauch Chunk* it amounts to 106 miles.

Freights.

Representing the latest actual charters up to July 14, 1876.

Per ton of 2240 lb.

Ports.	From Philadelphia.	From Baltimore.	From Georgetown.	From Elizabethport, Port Johnson, South Amboy, Hoboken and Weehawken.
Augusta, Me.	....	1 90	....	....
Albany	†80	...	...	....
Amesbury, Mass.	....	....	....	....
Bangor, Me.	....	1 60	....	90
Bath, Me.	1 45	1 45	1 45	90
Baltimore	....	....	....	....
Boston, Mass.	1 15@1 30	1 45	1 50	1 00
Bridgeport, Ct.	†1 00	1 35	....	60
Bristol, R. I.	....	....	....	80
Cambridgeport, Mass.	$1 25@1 35	....	...	90
Derby	....	....	....	....
Dighton	....	....	....	....
East Cambridge	$1 25@1 35	....	....	$90
Fall River	1 20@1 25	1 40	1 35	80
Hackensack	*70	....	....	....
Hallowell, Me.	....	....	....	....
Hartford	*70	....	....	....
Hoboken	†70	1 25	1 20	40
Hudson	....	....	1 35	....
Jersey City	70	1 25	1 20	40
Lynn, Mass.	....	....	....	†1 00
Middletown	....	....	....	1 00
Mystic	....	....	....	....
Newark	71	....	1 35	....
New Bedford	1 15@1 25	1 40	1 40	80
Newburyport	1 30	1 55	1 55	1 00
New Haven	1 00	1 35	1 35	60
New London	1 20	1 35	1 35	65
Newport	1 15@1 25	....	....	80
New York	1 00†	1 25	1 25	40
Norwalk	1 00	1 50	....	60
Norwich	1 20‡	....	....	70
Pawtucket	1 25‡	....	....	....
Philadelphia	....	....	....	....
Portland	1 25	1 40	1 40	90
Portsmouth, N. H.	1 30@1 40	1 60	1 00	1 00
Providence	1 15@1 25	1 35	1 35	80
Poughkeepsie, N. Y.	....	....	....	....
Rockport	....	....	....	....
Saco	....	....	....	....
Sag Harbor	....	....	....	1 00
Salem, Mass.	1 25@1 35	1 50	1 50	90
Salisbury Pt., Mass.	....	....	....	....
Stamford	*70	....	....	60
Stonington	....	....	....	80
Taunton	....	....	....	....
Troy	†80	....	....	....
Warren, R. I.	....	....	....	80
Wareham	....	....	1 45	....
Weymouth	....	....	....	....

*And discharging and towing. † And discharging. ‡ And towing. § 30c. per bridge extra.

Freights on Bituminous Coals from the Mines to Tide Water Shipping Ports.

From the Mines to Cumberland and State Line (say an average of 20 miles), the legal charge is 2 cents per ton of 2240 lb. per mile.

From State Line to Amboy (346 miles) $4 per ton of 2000 lb On coal shipped beyond this point there is a drawback of 75 cents per net ton.

From Cumberland to Baltimore (178 miles) $2.02 per ton of 2240 lb., or $1.80 per net ton (½ cent per ton per mile for use of hoppers over C. & P. RR.).

From Cumberland to Georgetown (152 miles) by canal, $1.10. Tolls, 46 cents.

From the Mines to Piedmont, 4 cents per ton of 2240 lb. per mile on distances less than 4 miles, and 3 cents per ton per mile on distances over 4 miles, and 2 cents per ton per mile on distances over 10 miles.

From Piedmont to Baltimore (206 miles) $2.34 per ton of 2240 lb., or $2.08 per net ton.

From Osceola to Greenwich, Phila. (say 248 miles) per T. & C. RR, per ton bituminous coal of 2000 lb., less drawback of $1.46. $2.15; rate per gross ton, $2.60.

From Osceola to South Amboy, N.J., (317 miles) per 2000 lb., $4.03, less drawback, $1.03; rate per net ton, $3; add 12 per cent. for gross ton, 36 cents, terminal expenses, shipping, 20 cents; rate per gross ton, $3.56.

IRON MARKET REVIEW.

New York.

FRIDAY EVENING, July 14, 1876.

American Pig.—We are reported sales of 1,000 tons of the Thomas Iron Company's forge iron at $20, future delivery, and 400 tons of No. 1 Crane at $22. The better grades of forge and No. 2 foundry irons are firmly held. Upon the whole, the outlook for the iron trade is by no means encouraging. The Allentown Iron Company has, or is about, to blow out all of its furnaces; this, however, cannot affect the trade any, as about an equal number are blowing in. We quote No. 1 foundry at $22; No. 2, $20; and forge at $19@20.

Scotch Pig.—There is no business worthy of note doing in this article. The arrivals are greater than the

demand, and iron is being placed in store. The inclination to prices is rather a downward one. We quote Coltness at $30; Gleugarnock, $28@29; and Eglinton, $27.

Rails.—We are reported no sales, although there are sundry inquiries in the market. We quote iron rails at $39@42 at the mills, and steel at $56@61.

Old Rails.—We note a sale of 300 tons at $21.50.

Scrap.—We note a sale of 500 tons of old wheels on private terms. There is nothing doing in wrought scrap which is quoted at $27@28.

Philadelphia Iron Trade.

Weekly report of the Philadelphia Iron Market, furnished by Messrs. JUSTICE, COX, JR., & CO., Iron Merchants, 333 Walnut street, Philadelphia. Week ending July 13, 1876.

The stifling heat of the last two weeks has stopped what little business was struggling to the surface after the Fourth of July holidays, in fact, a more lifeless market was never known. Mills and foundries that hoped to start on Monday of this week are still standing idle. In one or two cases the men tried for half a holiday, but knocked off and are waiting for cooler weather, whilst the lack of orders make the employers equally indifferent as to how soon they begin work. The Montgomery furnace went out of blast on Monday of this week to wait for better times, when they can get a new dollar for an old one, which they say is impossible to get at the present prices. One of the St. Charles furnaces also went out last week to line up, etc. So we find the low prices are crowding out of blast a furnace here and there until the few that stay in will have it their own way, and we will be surprised if they do not get their own price for a month at least.

We quote No. 1, $22 to $23; No. 2, $20 to $21; Gray Forge, $19.50 to $21.

BARS as in our last, are unusually dull of sale. We quote $2.35.

RAILS are dull at $39 to $42 for iron and $58 to $62 for steel.

Baltimore. July 12, 1876.

Specially reported by Messrs. R. C. HOFFMAN & Co.

The iron market continues dull and sales are limited to immediate needs and consumers. We have no change to note in prices.

Baltimore Charcoal	$30@35	Anthracite No. 3	$20@21 00
Virginia Charcoal	28@34	Mottled and White	17@19 00
Anthracite No. 1	23@24	Charcoal C.B. Blooms	65@67 50
" No. 2	21@22	Refined Blooms	50@55

Boston. July 8, 1876.

PIG remains in a state of business lethargy. Here and there a holder seems quite confident of a better near future, but this makes no impression on buyers, who cannot be induced to buy a ton more than they have immediate occasion for by any inducement of quotation. There is very little attachment to brands. By some peculiar method many of our buyers have been and are being supplied with new and previously unheard-of brands that in breaking, working, and finishing cannot be distinguished from very old and favorite makes. The same irregularity as to prices continues, a No. 1 will quote from $24 to $27, a No. 2 from $22 to $24, and gray forge from $20 to $23.

Buyers need to shop with great caution, and in making postal inquiries from even 25 different brokers and holders for as small as five ton lots will be amply repaid with the facts elicited of the underlying anxiety to sell. Make your terms cash on receipt of bill of lading, and send your inquiries not only to the sea-board cities but West and Southwest. An interior Massachusetts founder last month picked up a 50-ton lot from South of Hamilton, Ohio, of a famous Eastern brand laid down in his yard $1 08 a ton less than any Atlantic city broker quoted him. Freights from the West it will be observed are low.

BAR holds along in a dull and flabby way, quoting with a little irregularity, but only in one or two exceptional cases as low as $50 for guaranteed refined and possibly nowhere above $52 on machine or jobbers orders. To blacksmiths and petty workers wanting credit, 2¼c.@2 3-5c. is asked, though the nearly a range of 2-5c. does not sufficiently allow for the selection and time. There is no little talk about strengthening the Eastern Mill Association, but as the Western compact seems to be offset to a degree by the inducement of freighters, it does not seem possible that any renewal of the tone maintained here through June will occur again until the railway fight is ended.—*Commercial Bulletin.*

Chattanooga, Tenn. July 11, 1876.

Specially reported by J. F. JAMES. pig iron broker, etc., 233 Market Street.

The market here remains dull and inactive. No change in demand or prices to report.

The usual four months is given on quotations below:

Tenn. Ala. and Ga. Charcoal,	No. 1 foundry		$21@ 22
" " " "	No. 2 foundry		20@ 21
" " " "	gray forge		17@ 18
" and Georgia coke,	No. 1 foundry		18@ 19
" " "	No. 2 foundry		17@ 18
" " "	gray forge		15@ 16
White and Mottled			14@ —
Tennessee and Georgia cold-blast car wheel			24@ 25
Alabama " "			24@ 25
Old Rails		cash	22 00
Cast Scrap		"	12
Wrought Scrap		"	16

Cincinnati. July 11, 1876.

Specially reported by Messrs. TRABER & AUBERY, commission merchants for the sale of pig iron, blooms, ore, etc.

Most of our foundries and rolling mills have stopped for repairs, etc., consequently our market is very quiet. We quote:

CHARCOAL.

Hanging Rock, No. 1 Foundry		$25 00@	—4 mos
" No. 2, "		23 00@	—4 mos
" Mill		21 00@22 00	—4 mos
Tennessee, No. 1, Foundry		23 00@24 00	—4 mos
Tennessee, No. 2, "		22 00@23 00	—4 mos
" Mill		21 00@	—4 mos
Missouri, No. 1, Foundry		@	—4 mos

STONE COAL.

Ohio, No. 1, Foundry		22 50@23 00	—4 mos
" No. 2, "		22 50@21 50	—4 mos
Ohio Mill		20 00@	—4 mos
Missouri, No. 1 Foundry		25 00@26 00	—4 mos
" No. 2, "		23 00@24 00	—4 mos
" Mill		23 00@24 00	—4 mos

CAR-WHEEL.

Hanging Rock, C. B		40 00@45 00	—4 mos
Tennessee "		30 00@32 00	—4 mos
Missouri "		33 00@35 00	—4 mos
Alabama "		28 00@32 00	—4 mos

BLOOMS.

Charcoal		60 00@ 75 00	—cash

SCRAP IRON.

Cast		50c.@ 85	—cash
Wrought		1 00@1 40	—cash

Cleveland, Ohio. July 11, 1876.

Messrs. C. E. BINGHAM & Co., quote as follows:

Per gross ton, on four months' time. Subject to change in market. Discount for cash 4 per cent.

FOUNDRY IRON.

No. 1, Lake Superior Charcoal		27 00@....
No. 2, " " "		26 50@....
No. 1. Anthracite		25 50@....
No 2, "		23 00@....
No. 1, Bituminous		25 00@....
No. 2, "		23 00@....
American Scotch, No. 1, Cherry Valley		27 00@....
" " B—1, " "		26 00@....
" " No. 2, " "		24 00@....
No. 1, Massillon		26 50@....
B—1, "		25 00@....
No. 2, "		22 00@....

CAR WHEEL AND MALLEABLE IRON.

No. 3 Lake Superior Charcoal		27 50@....
No. 4 " " "		27 50@....
Nos. 5 and 6 "		27 50@....

BESSEMER IRON.

Nos. 1 and 2 Lake Superior Charcoal		27 00@....

FORGE IRON.

No. 1, Gray		22 00@....
White and Mottled		20 50@....

Louisville. July 11, 1876.

Specially reported by Messrs. GEORGE H. HULL & Co.

The market is without change. Consumers still adhere to the hand to mouth policy, and their stocks in consequence are small. With few exceptions the stock in first hands is also small, so that when trade does become active it must almost necessarily cause an advance in prices.

The usual time, four mos., is allowed on the quotations below:

HOT BLAST—CHARCOAL.

No. 1 Foundry, from Hanging Rock Ores		$24 00@26 00
No. 2 " " "		22 00@23 00
No. 1, Mill, from " "		20 00@21 00
No. 1, Foundry, from Alabama, Georgia and Tennessee ores		22 00@23 00
No. 2, Foundry, from Ala., Geor'a and Tenn. ores		21 00@22 00
No. 1, Mill, from " " " "		20 00@21 00

HOT BLAST—STONE COAL AND COKE.

No. 1, Foundry, from Hanging Rock Ores		22 00@23 00
No. 2, " " " "		21 00@22 00
No. 1, Mill, " " " "		20 00@21 00
No. 1, Foundry, from Ala. Ga. and Tenn. Ores		22 00@23 00
No. 2, " " " "		20 00@21 00
No. 1, Mill, " " " "		19 00@20 00
No. 1 Foundry, from Missouri Ores		—— @ ——
No. 2 " " " "		—— @ ——
No. 1 Mill, from Missouri Ores		24 00@25 00

COLD BLAST—CHARCOAL.

Car Wheel from Hanging Rock Ores		35 00@40 00
" " Tennessee "		28 00@30 00
" " Alabama and Georgia Ores		28 00@38 00
" " Kentucky Ores		28 00@38 00

Milwaukee. July 11, 1876.

Iron remains much the same—sales small.

per ton of 2,240 lb.

Frankfort L. S. Charcoal,	No. 1	$28 00
" " "	No. 2	27 00
" " "	No. 3, 4 & 5	25 00
" " "	No. 6	25 00
Mil. Anthracite L. S.,	No. 1	27 00
" " "	No. 2	26 00
Wisconsin Iron,	No. 1	26 00
Mahoning Valley Bit's	No. 1	32 00
" " "	No. 2	30 00

Pittsburg, Pa. July 12, 1876.

Specially reported by A. H. CHILDS.

Prices remain unchanged, notwithstanding the long-continued dullness of the market, and holders are strengthened in the belief that bottom has been reached at last. Quotations are:

No. 1 Foundry	24@25—4 mos.
" 2 "	22@23 "
Gray Forge	21@22 50 "
White and Mottled	18@20 "
Warm blast Charcoal	23@30 "
Cold blast Charcoal, Western	40@45 "

PIG IRON.—The general situation has not varied much since the date of our last report; business continues exceedingly dull, commission merchants are doing next to nothing, and the outlook at the present writing is not very promising. Some of the mills have stopped entirely, while but few of those in operation are running double turn, hence the consumption of pig is very small, and there is no disposition to anticipate future wants. Another month may put an entirely different face on things, and we are in hopes that it will; if there should be anything like an average Fall trade in the products, there will no doubt be an improvement in the raw article, both as regards demand and price. The strongest point in favor of the producing interest is the very light stock, and then the production is also very much reduced, a large percentage of the Western furnaces being out of blast; the stock of pig in this market is down lower than it has been for several years. The supply of No. 2 Hanging Rock foundry is almost exhausted, and it is being sold just about as fast as it arrives, and there is but very little coming forward; there is a fair stock of No. 1, and very little call for it. This is owing to the fact that founders have been using No. 2 in place of No. 1, in consequence of it being so much cheaper, hence the supply of No. 1 has been accumulating, while that of No. 2 has been kept down. The stock of bituminous coal smelted is also down pretty well, not only here but at the source of supply, and, as already intimated, the outlook in this respect is favorable to producers. As compared with last week, however, there has been no change whatever in prices, or for that matter the fluctuations have been very slight for several months; and while the future is uncertain the feeling prevails among well-informed operators that the lowest notch has been reached.

There are no sales making excepting in a small way, and not likely to be for some weeks, as buyers are all adhering closely to the old policy of buying as their immediate necessities require.

MANUFACTURED IRON.—The demand for nearly everything in this line continues light, as it nearly always is at this season of the year, and it is not likely that there will be any general or permanent improvement until after harvest. Some of the sheet mills are busy, nearly all of them are pretty well supplied with orders, and others are doing a fair business in specialties of one kind or another, but, as already intimated, business in general is dull, and the demand for the leading sizes is light. Prices firm but unchanged; we continue to quote at $2.30@2.50, 60 days, according to size of order. Small dealers or consumers ordering less than 10 tons (a carload) should bear in mind that full card rates are charged, $2.50, 60 days. One of the most satisfactory features of the market is an entire absence of the ruinous cutting of rates, so common prior to the formation of the Western Association, and in this most important respect the combination is a success.—*American Manufacturer.*

Richmond, Va. July 11, 1876.

Reported by ASA SNYDER, Esq.

Transactions in charcoal pig iron continue very light. No change in quotations.

Virginia Cold Blast Charcoal Pig Iron						$27 to	$33
" Warm " " " "						24 to	28
" " " Coke " "				1 X		23 to	24
" " " " "				2 X		21 to	22
" " " " "				3		20 to	21
" Anthracite	1 X					— to	—
" "	2 X					— to	—
" "	3					— to	—

St. Louis. July 11, 1876.

Specially reported by Messrs. SPOONER & COLLINS, Commission Agents for all kinds of Iron.

We note no change from last report, either in price or demand. Everything is very quiet—trade very dull.

We quote same as last.

Mo. Stone Coal	No. 1 Fy.	$25@26	Massillon iron, A No 1	29@30
" " "	2 "	23@24	" " B "	1 3.4@—
" "	Gray Mill,	22½@23	" " "	2.28@—
" Charcoal	No. 1, Fy.	23@24	Cold Bl. Car Wheel, Mo.	30@33
" " "	2, "	22@23	" " " Tenn.	30@33
" "	Gray Mill,	22@23	" " " Ala.	30@33
Tenn. "	No. 1, Fdy	23@24	" " " H. R.	33@35
" " "	2, "	22@23	Mo. Charcoal Blooms	50@65
" "	Gray Mill	22@23	" Scrap "	45@55
Va. Coke,	No. 1, Fdy.	24@25	" " hammer- ed Billets	75@80
" " "	2, "	23@24	" "Gray Mill,	21@23
H. R. Char.	No. 1, Fdy.	25@26	Assorted Bar Iron 2 50, 60 days	
" " "	2, "	24@25	No. 1 Wrought Scrap 90c. cwt.	
" "	Gray Mill,	24@25	Heavy cast " 70 "	
			Light " " 50	

Montreal. July 7, 1876.

We continue to quote: Pig iron Eglinton and Clyde $19@20.00; Carnbroe $20.00@21 00; American $22@24; Summerlie and Calder $20@21; Langloan and Gartsherrie $21@22; Coltness $21.50@22.00; Hematite $27@28. Bar, per 100 lb., Scotch and Staffordshire, $2.15@2.25; best do., $2.40@2.50. Swedes and Norway $4.75@5.50; Low Moor and Bowling, $6.50@7.—*Monetary Times.*

METALS.

NEW YORK, FRIDAY EVENING, July 14, 1876.

There is a little more business doing than last week, and the feeling has improved a little. A few articles show slightly enhanced values.

Gold Coin.—During the week under review gold has ranged from 112⅛@111¾, and closed at 111⅛.

Bullion.—Owing to the small quantity of silver bullion offering on the London market at current rates prices have advanced to 47⅛@48d. This market is quoted at 104@104½, while the San Francisco market has advanced to 15⅛ per cent. discount. The report of the Conference Committee on the Silver Bill, was adopted in the House, yesterday, by a vote of 128 in the affirmative, to 76 in the negative. The bill authorizes the Government to purchase $20,000,000 of silver bullion, and should it become law, of which there is no doubt expressed, the price of silver will likely improve considerably. Gold bars are unchanged in price.

Copper.—There have been sales during the week under review of 400,000 to 500,000 lb. of ingot copper at 20c.@20¾c. The rumor (which is not discredited, although particulars are kept private) that another large lot of copper has been sold for export, has had but little influence on the market, although it would make the statistical position a very strong one. The closing quotations are 20¾c.@20⅞c. Cable advices of the 8th inst., quoted Chili Bars in London at £73, and Best Selected at £79, a decline of £1 on the latter, and £1 10/ on the former.

Tin.—Straits is quoted in London at £74 10/, and in Singapore at $22, with an upward tendency. The former figure shows a decline from last week of 10/, and the latter an advance. Quotations here are as follows, in gold: Straits, 17½c.; L. & F., 17¼c.; and Banca, 21⅛c. There is but very little business doing.

Tin Plates.—Owing to the continued decrease in production in Wales and the failure of some of the manufacturers, prices have advanced 1/5 a box. There has been a very fair business done in this market at advanced prices, the market closing at the following quotations, gold, per box: Charcoal tins, $7.25@7.50, and terns, $6.75; coke tins, $6.25, and ternes, $6.

Messrs. ROBERT CROOKS & Co., of Liverpool, under date of June 29, says of tin plates: "A firmer feeling decidedly prevails, but, so far, only coke tins are thereby effected, and it is just a question whether there may not again be a relapse, as some makers must, for financing reasons, sell, and they will find considerable difficulty in meeting with buyers at an advance. Charcoal tins, especially lower grade, are still offering very cheap, and apparently are in small demand.

Lead.—We are reported sales of about 100 tons of common domestic, at 6·20c.@6¼c. gold, which are the closing quotations.

Spelter and Zinc.—Domestic spelter is quoted at 7¼c.@7⅛c. currency. The combination to sustain the price of this article, appears to have been a failure. Sheet zinc is quite at 8¼c.@8¾c. gold.

Antimony is quoted at 15¾c. gold.

Quicksilver.—The London market has declined to £8 per flask; this market, 51c.@53c. per lb; and San Francicco, 47c.@48c.

FINANCIAL.

New York Stocks.

FRIDAY EVENING, July 14, 1876.

OUR record of the transactions at the New York Stock Market for the period under review, indicates a total of 31,748 shares. The fluctuations still continues to exhibit the irregularity which has characterized the principal quotations for several weeks past.

New Jersey Central Railroad.—2 per cent. represents the difference between the extreme prices of this stock during the week. About 14,000 shares have changed hands, finally closing at 71¾, a decline of nearly 2 per cent.

It is officially announced that this company has negotiated the balance of its consolidatad mortgage bonds through a foreign banking house here. This makes a total issue of $15,000,000, the remainder being held in reserve, according to the terms of the mortgage, against the outstanding first mortgage and convertible bonds, and the Newark and New York Railroad Company's bonds.

Delaware, Lackawanna, and Western Railroad—This stock has sold down to par, but finally recovered to 102, at which figure it closed. Nearly 17,000 shares have changed hands during the week, within 5 per cent. as the limit of the extreme prices. It is stated that the engineers on this road, are enthusiastic in the praise of the new gauge. The locomotive will draw trains of the same weight on the narrow guage with 10 per cent. less steam.

Delaware and Hudson Canal Company.—The dealings in this stock represent a total of 323 shares for the week, the final price being the same as recorded at the close of the market in our issue of the 8th inst. This company announces a semi-annual dividend of 4 per cent. (instead of 5 per cent. as formerly), payable August 1st.

Consolidation Coal Company.—50 shares of this stock sold during the week at $40 per share, being the only transaction. The closing quotation was 39¼. The Trustees of this company have issued the following announcement: To the holders of the first mortgage bonds of the Cumberland Coal and Iron Company. Proposals will be received at the office of the Consolidation Coal Company, for the sale to them of the whole, or any part, of forty thousand dollars of said bonds for the purpose of the Sinking Fund.

Mariposa Land and Mining Company.—This stock is unchanged; 200 shares were sold during the week at $8 per share. A sample of the richer ore from the tunnel has been assayed at the United States Assay Office, and yielded $178 per ton.

Bonds.—The dealings in these have again been very large, $243,000 representing the total transactions; $175,000 of this was in the Lehigh and Wilkes-Barre consols., the prices of which have only fluctuated ⅛ per cent. during the operations of the week. The general quotations of the list, however, are irregular.

The Swedes Iron Company.—The coupons on the bonds of this company are payable during the present month.

Thomas Iron Company.—The coupons on the bonds of this company are payable during the present month.

The Winthrop Iron Company of Lake Superior will hold its annual meeting on the 29th inst.

The Bay Furnace Company will hold its annual meeting at Marquette, Mich., on the 17th inst.

The Morgan Iron Company will hold its annual meeting at Marquette, Mich., on the 29th inst.

The Huron Bay Slate and Iron Company will hold its annual meeting at Marquette, Mich., on the 20th inst.

The Houghton (Mich.) Copper Works Company will hold a special meeting on the 14th of August.

The Bethlehem Iron Company. At the recent annual meeting of this company, in Bethlehem, Pa., the following gentlemen were elected to serve as directors for the ensuing year: ALFRED HUNT, JOHN KNECHT, R. H SAYRE, JOSEPH WHARTON, JACOB RIEGEL, E. B. WILBUR, and G. B. LINDERMAN.

Longwood Valley Railroad.—This road is now completed to Kenvil, N. J., five miles beyond Flanders and 21 miles north by east from the junction with the Central Railroad of New Jersey at High Bridge. The Branch from near German Valley to Chester, about three miles, is also completed. The stations on the new line are High Bridge, California, Middle Valley, German Valley, Chester (branch), Naughtright, Bartley, Flanders and Kenvil. Regular trains began to run this week. The road has been built and is worked by the New Jersey Central Railroad Company, and is known as the High Bridge Branch, and reaches some large iron mines and deposits

Utica, Ithaca and Elmira.—At a recent meeting of this company the following gentlemen were elected directors: EDWIN ELDRIDGE, H. W. RATHBONE, F. N. DRAKE, of Elmira, New York; F. C. CORNELL, O. B. CURRAN, J. F. HIXON, Ithaca; H. P. GOODRICH, Cortland H. V. POOR, Brookline, Massachusetts; A. B. CORNELL, H. W. POOR, New York; JOSEPH RODBOURN, JAMES H. RODBOURN, Bressport; D. D. REYNOLDS, Horseheads. The following officers were elected for the ensuing year; President, Dr. EDWIN ELDRIGE; vice-president and and general manager, JOSEPH RODBOURN; treasurer, O. B. CURRAN, secretary, R. M. MCDOWELL; auditor, M. W. SERAT. This change of management is of much importance, as we understand that it identifies this road more closely with the bituminous coal interests of Tioga County, Pennsylvania Dr ELDRIDGE and associates control the heavy coal interests of the Blossburg districts; the Tioga Railroad the outlet for the bituminous coal mined there, and the new Lawrenceville road to Elmira, connecting the Tioga Railroad with the Utica, Ithaca and Elmira Railroad. They also own the Elmira, Iron and Steel Rolling Mill and blast furnaces. They have assumed control of the Utica, Ithaca and Elmira to operate it in more intimate relations with the Tioga Railroad and the coal mining companies of Blossburg, as well as for the transportation of their ores and limestone for their furnaces, securing a large prospective business for the road.

Iowa Coal, Railway and Manufacturing Company. This company has, during the past year, constructed a line 3¼ miles long, from the Chicago and Northwestern near Boonesboro, Ia., to its coal mines in Boone County The road is intended chiefly to transport the coal from those mines.

Quotations and Sales of Stocks and Bonds.

For the week ending July 14, 1876.

STOCKS.

	Highest	Lowest	Closing	Shares sold.
Pennsylvania Coal Co	—	—	245	—
Consolidation Coal Co	40	39¼	39¼	50
Spring Mt. Coal Co	—	—	*53¾	—
American Coal Co	—	—	*54	—
Maryland Coal Co	—	—	*12½	—
Del., Lack., and West. RR. Co	105	100	102	16674
New Jersey Central RR. Co	74¼	71⅝	71¾	14201
Delaware and Hudson Canal Co	108¾	106½	106½	323
Quicksilver Mining Co. pref'd	—	—	18	—
" " Common	—	—	13½	—
Mariposa Land & Min. Co, pref'd	8	7	7	200
St. Louis & Iron Mountain RR	17⅛	17	17	300
Lehigh & Wilkes-Barre Coal Co	—	—	—	—
Total Shares sold				31748
Sales for the week previous				22068
Increase				9680

* Nominal.

BONDS.

	Inter'st	Sales.	Price.
Del., Lack. & West. 2d M	M. & S.		@
" " " 7's Con'ble	J. & D.		@
Cent'l RR. of N.J., 1st M., New	F. & A.	4,000	@114½
" " " 1st Cons.		12,000	@101¾
" " " Convert'le	M. & N.	49,000	97 @ 98
Lehigh & W.-B'e, Con. Guar'd.		175,000	87 @ 87½
Am. Dock & Imp. Mt. Bonds	J. & J.	2,000	@ 96½
Del. & Hud. Can., 1st M., 1891		1,000	@110¾
" " " 1884			@
" " " 1877			@
" " " Coup. 7's, 1894			@
" " " Reg'd 7's, 1894			@
St. L. & Iron Mountain, 1st M	F. & A.		@
" " " 2d M	M. & N.		@*79
Chesapeake & Ohio 6's, 1st M			@
" " " Ex. Coupon			@
Mariposa Gold Loan con. 7s			@*100½
Total sales		$243,000	

* Nominal.

Philadelphia Stocks.

PHILADELPHIA, Thursday Evening, July 13, 1876.

The sales at this market for the week aggregate 27,736 shares. The range of prices do not call for special comment, the majority of quotations being generally steady.

Pennsylvania Railroad.—About 13,000 shares of this stock have changed hands at from $52⅝ to 53, closing at the lower figure, the range during the week being confined to ⅜. This company has been examining and exploring the "Gap Ridge," with the design of tunneling it about two miles to the westward of that place, in order to straighten the road and to avoid the heavy gap grade, and have come to the conclusion that the tunneling at that place is impracticable, on account of the quicksand which is supposed to extend under the ridge, westward, and on account of the great cost, which has been estimated at one million of dollars. They have now commenced sounding the quicksand in the gap to ascertain its depth, and have found solid rock bottom in one place near the summit, not more than ten or twelve feet below the bed of the road. They intend continuing their soundings, with a view of sinking and straightening the track in the gap. The shafts are sunk by a contrivance such as is used in sinking artesian wells, and thus far it has worked successfully. The gap section has been the most difficult one on the road to manage from the beginning.

Reading Railroad.—This stock has sold to the extent of 6 264 shares, closing ¼ higher, the extreme range for the week being represented by the same fraction.

Lehigh Valley Railroad stock continues to improve. To be sure the difference is but a fraction, yet even that, in the face of a generally declining market, is worthy of remark. The total transactions for the week amount to 830 shares.

Lehigh Coal and Navigation Company.—This stock has sold to the unusual extent of 7,652 shares, between 43¾ and 45 as the outside figures, finally closing at the lowest price of the week, a decline of ¼ from the latest price in our last.

The Schuylkill Navigation Company announces a dividend of sixty cents per share on the preferred and thirty cents per share on the common stock of the company, payable in cash August 5.

The Volcanic Oil and Coal Company has declared a dividend of twenty-five cents per share payable on the 15th inst.

Minersville Coal and Iron Company.—At the stockholders meeting of this company, held on the 19th ult., for the purpose of electing officers, it was resolved not to enter into a new election, consequently the old officers hold over.

Auction Sales of Stock and Bonds for the week have been as follows:

Ogden Iron Company.—62 shares par $100 at from $41 to $45 per share.

Lehigh Coal and Navigation Company.—$5,500 6 per cent. bonds due in 1877, at 95 per cent.; also $5,000 1st mortgage 6 per cent. bonds at from 102 to 102¼ per cent.

Lehigh Valley Railroad.—$6,000 6 per cent. bonds at from 107½ to 107¾ per cent.

Pennsylvania Railroad.—$2,000 6 per cent. bonds due in 1880 at 104⅛; also, $1,000 general mortgage 6 per cent. bonds at 103¼ per cent.

Philadelphia and Reading Railroad.—$3,000 6 per cent. bonds at 104¼ per cent.

Bonds.—The transactions in these exhibit an increase without any special change in prices.

Quotations and Sales of Stocks and Bonds.

For the week ending July 13, 1876.

STOCKS.

	Highest	Lowest	Closing	Shr's
Lehigh Valley RR. Co	57⅝	57	57⅝	830
Pennsylvania RR.	53	52⅝	52⅝	12990
Reading RR.	44⅞	44¾	44¾	6264
Lehigh Coal and Nav. Co	44⅞	43⅞	44	7652
Penn. Canal	—	—	*9	—
Buck Mountain Coal Co.	—	—	*25	—
Fulton Coal Co.	—	—	*3¼	—
Locust Mountain Coal Co	—	—	—	—
Westmoreland Coal Co	—	—	75	—
St. Nicholas Coal Co	—	—	*1	—
Cambria Iron Co	—	—	15½	—
Crane Iron Co	—	—	*25	—
Emaus Iron Co	—	—	—	—
Pennsylvania Salt Manufact. Co	—	—	70½	—
Total shares sold				27,736
Sales for the week previous				16,659
Increase				11,077

* These quotations are nominal.

BONDS.	Sales.	Price
H and B. T. RR. 1st mortgage, 7s	—	— @107
" " " 2d " "	—	— @104
" " " 3d " cons	—	— @ 43
Lehigh Valley RR. Con. mtg. 6s	49,000	99¼@ 99⅜
" " " 7s, 1910	5,000	— @113
" " " 6s coup	2,000	— @107
" " C. M. 6s 1923	—	— @ 99¾
Pennsylvania RR., 1st mtge. 6s	4,000	104⅛@105
" " gen. " cou. 1910	11,000	103⅛@104
" " gen. " 6s, reg	2,000	— @106
" " Cons. M. 6s reg	—	— @ 98
Phil. & Reading RR. 7s '93	—	— @107
" " G. M. 7s, reg.	1,000	— @106
" " " 7s cou.	3,000	— @107
" " new convertible 7s	9,500	— @ 98
" " 6s 1880	1,000	— @105⅛
Phil. & Reading C. & I. Co. Deb. 7s	—	— @—
" " Locust Mount. tract	3,000	— @ 80
Lehigh Coal & Nav. Co., 6s '84	4,000	— @102⅛
" " " RR. 6s, '97	—	— @105
" " " cov. m. 7s	—	— @—
" " " 6s gold loan	2,000	— @103
Penn. Canal, 6s	1,000	— @ 72½
Penn. and N. Y. Canal, 7s	—	— @108
Ches. and Del. Canal, 6s	—	— @—
Susquehanna Canal, 6s	—	— @ 70
Delaware Division Canal, 6s	—	— @—
Susquehanna Coal Co. 6s	—	— @ 77
Buck. Mount Coal Co. 6s	—	— @—
Penn. Gas Coal Co. 6s	—	— @—
Honeybrook Coal Co. 7s	—	— @—
Total amount of sales	$97,500	

Closing quotations, in the absence of sales, represent the latest prices bid.

Gold and Silver Stocks.

NEW YORK, FRIDAY EVENING, July 14, 1876.

With but a few exceptions, we note a further decline in the mining share list. Various reasons are given to account for this continued decline, among which may be mentioned 1st. The fall in the price of silver. 2nd. The difficulty of working in the lower levels of the mines on account of the bad air, and the flooding of water. 3rd. The withdrawal of a large amount of money from the market, to move the California grain crop. A recent number of the San Francisco *Bulletin*, in commenting on this decline, says:

"The recent soft tendency in the shares of the California and Consolidated Virginia Mines has shaken the faith of some of the stockholders in the permanency of all mining values. Every dividend paid by the Consolidated Virginia Mine for the past six months has been followed by a decline in the stock considerably greater than the amount of the dividend. In January the shares were in the nineties; in February and March they were kept for the most part in the eighties, but soon fell to the seventies, where they remained in May and for a portion of June. After the June dividend, they got into the sixties, and during most of the current week they have been in the fifties. The multiplication of shares which took place in March, led many to believe that the large owners were getting ready to shed their stock, and this probably has contributed to the depression. During the year 1875, the record of transactions at the San Francisco Stock Board shows that 79,000 shares of Consolidated Virginia changed hands, equal to 395,000 shares of the present issue. On the basis of the new stock the sales this year have been as follows:

January shares	49,500	April, shares	54,400
February	24,500	May	20,400
March	29,000	June to 24th	35,100
Total			200,500

"The above sales were made at only one of the Boards. Taking $90 as the average of the stock in January and $60 as the average now, we find the depreciation in the value of the mine to have been as follows:

January	$48,600,000	
June	32,400,000	
		$16,200,000
Dividend six months	$6,480,000	
Working expenses	3,000,000	
		9,480,000
Depreciation unaccounted for		$6,720,000

C. and C. Joint Shaft.—The connection between this work and the two bonanza mines is completed and thus another outlet has been formed from the 1,500-feet level of these mines.

California.—Daily yield, 500 tons of ore; the ore breasts on the 1,500-feet level are looking splendidly and are yielding rich ore. The ore breasts are also being opened on the 1,550-feet level preparatory to extracting ore. The east and west cross-cuts on the 1,600-feet level are each still in rich ore, and that level is giving promise of a richer, better yield of ore than either of the levels above, in fact the more the mine is opened the richer and better it shows. On the 1,400-feet level two cross-cuts are being run to cut and prospect the ledge further to the northward than it has yet been developed. The yield of bullion for June will exceed that for the month of May.

Consolidated Virginia.—Daily yield, 350 tons of ore. The mine is looking well, and with the exception of three or four days of unavoidable delay in making necessary repairs, has shown no change in any respect whatever. The station at the 1500-feet level has been completed. On the 1400-feet level the drifts and winzes are being enlarged, so as to give a better passage for the air and cool the level. On the 1500-feet level a drift has been run west to tap the bottom of the shaft, and enable the extraction of ore from that portion of the mine. The east drift on the 1500-feet level, has been connected with the west drift from the C. and C. shaft, and although the draft of air is not so strong as expected in the beginning, the benefits will soon be apparent in the steady cooling of the whole mine. The north drift, on the 1700-feet level, is steadily advancing, and taking into consideration the large size of the drift, and the intense heat encountered, is making good progress.

Ophir.—Daily yield, 350 tons of ore. The ore breasts both north and south on the 1,600-feet level are showing finely and promise an excellent yield of good ore. The north drift on the 1,600-feet level is steadily advancing toward the south line of the Mexican, the face in porphyry. The mills are kept running up to their full crushing capacities, and the yield of bullion for June will exceed that of any month since the destruction of the hoisting works by the fire.

Imperial Consolidated.—The ore from the 2,000-feet level of this mine is very rich, running high in gold. Working the mine, however, is seriously interfered with on account of water.

The Sutro Tunnel was in, on the 1st of July, 13,638 feet, the rate of progress for the week amounting to 106 feet.

San Francisco Dividends.—The dividends paid by various mining and other companies doing business in San Francisco, for the first half of the present year, amounted to $12,508,000, being the largest amount ever disbursed for the same period, and $4,000,000 above the disbursements for the corresponding time last year.

QUOTATIONS:

	No. of feet on Vein.	No. of shares.	July 5.	July 13.
Sierra Nevada	3,300	100,000	$14	$13
Union Consol'd	600	100,000	—†	10
Mexican	600	108,000	28	27
Ophir	675	108,000	48	49
California	600	540,000	70	66
Consol'd. Virginia	710	540,000	53	48
Best & Belcher	540	100,800	45	42
Gould & Curry	612	100,800	15	13
Savage	771	112,000	21	18
Hale & Norcross	400	112,000	9	9
Chollar Potosi	1,400	28,000	76	72
Alpha Consol'd	366	30,000	46	38
Imperial Con	468	500,000	—†	5
Yellow Jacket	957	120,000	30	27
Kentuck	95	30,000	13	13
Crown Point	541	100,000	10	9
Belcher	1,040	104,000	17	18
Overman	1,200	38,400	65	61
Caledonia	2,188	100,000	8	8
Justice	2,100	105,000	23	21
Raymond & Ely	5,000	30,000	9	9
Meadow Valley	4,400	60,000	—†	1
Eureka Consolid	....	50,000	12	12
Eureka G. V	1,680	20,000	—†	3
Silver Hill	5,400	54,000	7	7
Julia	3,000	110,000	9	6

† We had no quotations of these stocks on this date.

Copper Stocks.

Specially reported by Messrs. WILSON W. FAY & Co., Bankers and Brokers, Room 7 Traveller Building, 31 State Street, Boston.

BOSTON, THURSDAY EVENING, July 13, 1876.

The market on copper stocks (although very dull), shows a marked improvement in the prices of producing mines. Calumet is strong at 164 bid. Copper Falls is firmer at 3¼ bid, over 1,200 shares changing hands, from 3 to 3¼. Duncan Silver has advanced from 1⅛ to 1⅜, but at this figure more stock is offered. Franklin, which was offered at 9⅞, is firm at 10 bid. National strong at 1¼ bid. No stock offering under 1¾. Quincy has made a jump from 43¼ to 46¼ bid. Pewabic is stronger at 2¾ bid. The rise in Ingot Copper to 20¾ is the probable reason for the advance. There are very few shares of any of the companies offering on the market, and a few orders to buy would advance the prices materially.

The Copper Product of the reporting mines for the month of June was as follows:

	Tons.	Lb
Calumet and Hecla	1185	865
Quincy	150	140
Franklin, 91 tons 110 pounds } Pewabic, 35 tons 465 pounds }	126	575
Osceola	109	156

Sales for the week have been as follows:—66 shares of Calumet and Hecla at from $164 to $164¼ per share; 1,225 shares of Copper Falls at from $3 to $3¼ per share; 140 shares of Quincy at $46 per share; 50 shares of Franklin at $10 per share, and 50 shares at $10⅛; Buyer, 60; and 100 shares of Duncan Silver at $1⅛ per share.

DESCRIPTION.	Par Value.	No. of Shares.	CLOSING. Bid.	Asked.
Allouez	$50	20 000	$ —	$12 00
Calumet and Hecla	25	80,000	164 00	164 50
Central	25	20,000	30 50	31 50
Copper Falls	50	20,000	3 25	3 50
Dana	25	20,000	9	12½
Franklin	25	20,000	10 00	10 50
Humboldt	25	20,000	9	12½
Madisca	25	20,000	27	30
Mesnard	25	20,000	37½	45
Minnesota	25	20,000	1 50	2 00
National	25	20,000	1 25	1 75
Osceola	25	40,000	21 00	22 00
Petherick	25	20,000	45	55
Pewabic	25	20,000	2 75	3 50
Phenix	25	20,000	12 25	12 75
Quincy	25	20,000	46 25	46 50
Ridge	25	20,000	—	—
Rockland	25	20,000	25	30
International Silver	20	60,000	10	12½
Star	25	20,000	—	—
Superior	25	20,000	10	12½
Duncan Silver	20	60,000	1 25	1 37½

Gas Stocks.

NEW YORK, FRIDAY EVENING, July 14, 1876.

WE advance the quotations of the New York and the Metropolitan Gas Companies $5 per share each. We learn of no transactions at private hands, and there is no doubt that a material concession from any of our quotations would be made on a purchase order of any importance.

Brooklyn Gas Company.—250 shares of this stock sold at auction on the 12th inst., at from $183 to $185 per share. We lower the quotation of this company $10 per share.

Nassau, Brooklyn, Gas Company.—$1,375 of the 7 per cent. scrip of this company sold at auction, during the week, at 88 per cent.

Peoples' Gas Company of Brooklyn.—We note an auction sale of 186 shares of this stock at $46 per share.

The Mutual, New York, Gas Company has declared a cash dividend of 2½ per cent.

London Gas Companies Consolidation.—A Bill is now before the House of Lords and passed its second reading, having for its purpose the consolidation of about two-thirds of the gas companies of London into a single corporation, under the title of the "Gas Light and Coke Company." We take the following information from *Capital and Labour*, of the 28th inst.:

"This amalgamation is to be accompanied by some new guarantees for the consumers. The price of gas over the whole district is to be three and ninepence a thousand feet, and the quality sixteen candles. The Bill empowers the local authorities to test the quality of the gas at certain points, and provides some means for enforcing the standards of power and purity. It is also provided that the dividend to the shareholders on their capital shall be ten per cent., as at present, but that it may be varied in proportion to the changes made in the price of gas. For every penny or part of a penny charged in excess of the price of three and ninepence a thousand feet, the statutory dividend is to be diminished five shillings per cent. On the other hand, for every decrease of a penny a thousand the dividend may be increased five shillings per cent. The Bill, therefore, insures that the initial price shall not be raised without serious reason, while the probability is that it will very soon be reduced considerably. It is believed that the gas can be well supplied at three shillings a thousand, and if it can be reduced to that price, the shareholders of the gas company may increase their dividend to twelve and a quarter per cent.

St. John's, New Brunswick, Gas Company.—We note small transactions in this stock, at from $104 to $105 per share.

The New Bedford, Mass., Gas Company, has declared a dividend of 4 per cent.

The Haverhill, Mass., Gas Company, has declared a dividend of $2 per share.

The Ashland, Pa., Gas Company, has declared a semi-annual dividend of 3 per cent.

Fort Scott, Kansas, Gas Company.—The coupons on the bonds of this company, will be paid during the present month.

The American Improved Gas Light Company, of Boston, will hold a special meeting on the 15 inst.

Knickerbocker Gas Light Company.—Articles of incorporation in behalf of the above company, have been filed in the County Clerk's office.

The capital stock of the new company is placed at $1,500,000. The incorporators and first directors are R. M. C. GRAHAM, JARED E. REDFIELD, TILTON E. DOOLITTLE, JOHN SICKELS, and GEORGE HOWES.

The following list of Companies in New York and vicinity are corrected weekly by GEORGE H. PRENTISS, Broker and Dealer in Gas Stocks, No. 30 Broad st., N. Y.

Quotations "bid" and "asked" of New York City and Vicinity Gas Companies are on the $100 of stock and not on one share.

Companies in New York and Vicinity	Cap. Stk.	Par.	last Div-vid.	When Paid.	Bid.	Askd.
			pr.c			
Mutual, N. Y.	$5,000,000	$ 100	2½	Jan. '76	112½	*113½
" " Bonds	900,00	1,000	13½	Feb. '76	105	
NewYork, "	4,000,000		5	Jan. '76	136	140
Metropol. "	2,500,000	100	5	Mar. '76	150	155
" " Certf.	1,000,000	....	3½	" "	103½	
" " Bonds	800,000	1,000	3½	Jan. "	102	102½
Harlem "	1,850,000	50	4	Feb. '76	118	122
Manhattan "	4,000,000	50	10	July "	235	240
Brooklyn, B'klyn	2,000,000	25	5	June '76	175	185
Nassau "	1,000,000	25	4	Jan. '76	70	78
" " Certf.	700,000	1,000	3½	Nov. '76	94	95
People's "	1,000,000	10	3½	Jan. '76	45	50
" " Certf.	300,000	1,000	3½	Jan. '76	85	87½
" " Bds	325,000	....	3½	Feb. "		95
Metropol. "	1,000,000	10	3½	Nov. '75	70	75
Wmsburgh "	1,000,000	50	5	Jan. '76	122	130
" " Certf.	1,000,000	....	3½	Jan. "	100	102
Citizen's "	1,200,000	20	2½	Jan. '76	88	90
" " Certf.	320,000	1,000	3½	April "	99	101
J. C. N.J.	386,000	20	5	July, '75	160	170
Centl. Westch. N.Y.	466,000	50	4	July. "	95	100
Subur'n " "	390,000	50				95

* Ex dividend, 2½ per cent. † Gold.

Companies out of Town.*	Cap. Stk.	Par	Bid	Askd
People's " " of J. C....			120	133
¶Citizen's G. L. Co., New'k. N.J.	1,095,000	50	85	90
Perth Amboy G. L. Co., N. J....		25		95
Hempstead" " L. I., N.Y.	40,000	100		100
Jamaica, " " " "	25.000	100		100
Richmond Co., S. I. "	300,000		100	105
Citizens', Rochester, "		100	45	50
Rochester Gas Co., "		100	50	
‖People's G. L. Co. Albany,"	1,000,000	100		25
§Mutual " Buffalo "	750,000	100	48	55
Mutual " Detroit. Mich.		50	18	
TroyG. L. Co., Troy, N. Y.....			108	
Citizens " " "	600,000	100		100
Brockport, N. Y., G. L. Co.	25,000	100	60	80
Saugerties G. L. Co.....	15,000	100	100	115
†Baltimore G. L. Co., Balt., Md	2,000,000	100	155	165
St. Louis G. L. Co., St.Louis, Mo	600,000		110	130
People's G. L. Co., Balt., Md	2,000,000	25	24½	25⅝
Hannibal G. L. Co., Hanni., Mo.	100,000	100	95	100
La Clede, St. Louis, Mo	1,200,000	100		102
Lewiston G. L. Co., Lewis., Me	400,000	100	50	85
Chicago G. L. Co., Chicago, Ill.	2,000,000	100	125⅛	
Jacksonville, Ill.....	120,000	100	82	
‡Lima, Ohio.....	60,000	100	10	
Derby G. L. Co., Derby, Conn..	160,000	100	60	80
Woonsakt G. L. Co.Woonsakt,R.I.	150,000	100	100	
Fort Wayne G. L. Co. F. W.,Ind		100	90	100
North. LibertiesG. L. Co. Phila.		25	29	
Wilkes-Barre G. L. Co W. B. Pa.		50	70	
Washington G. L. Co., Phila....			42	43
Pottsville, Pa., Gas Co....		50	40¼	
Portland G. L. Co. Portland, Me	350,000	50	72	75
Hartford G. L. Co., Hartford,Ct	700,000	25	41	
Boston G. L. Co., Boston, Mass.	2,500,000	500	785	790
East Boston, Mass		25	132	
Chelsea G. L. Co. Chelsea, "	300,000		139	
Cambridge G. L. Co., Cam., "	700,000		132¾	
Louisville G. L. Co., Louis., Ky.			127	
Cincinnati G. L. Co , Cincin, O..				200
Carondelet G. L. Co., Mo ...		50		6¼
S. F. G.L. Co. San Francisco,Cal	10,000,000	100	99¾	99½
Stillwater G. L. Co., Minn,....	50,000	50		26
City G. L. Co. Montreal, Can....	1,440,000	40	167	169
Consumers G. L (old.) Tor., Ont	600,000	50	134	
Hamilton G. L. Co., Ont.....	150,000	40	112½	
Halifax G. L. Co., Halifax, N.S.	400,000	40		147½

* These quotations represent the latest obtainable prices at which sales were made.

† This Company has issued $1,000,000 in certificates in addition to their stock indebtedness, on which they pay interest at the rate of 6 per cent. gold.

‡ This Company has $30,000 in bonds outstanding.

§ $200,000 represents the bonded indebtedness of this Company.

‖ $350,000 of the indebtedness of this company is represented by bonds.

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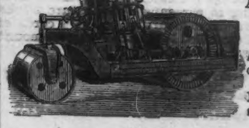

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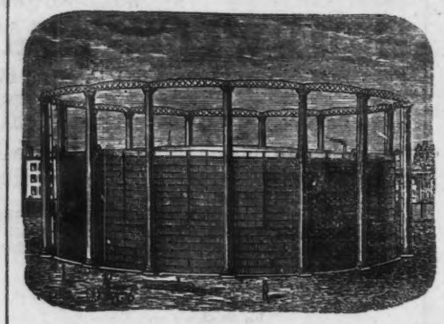

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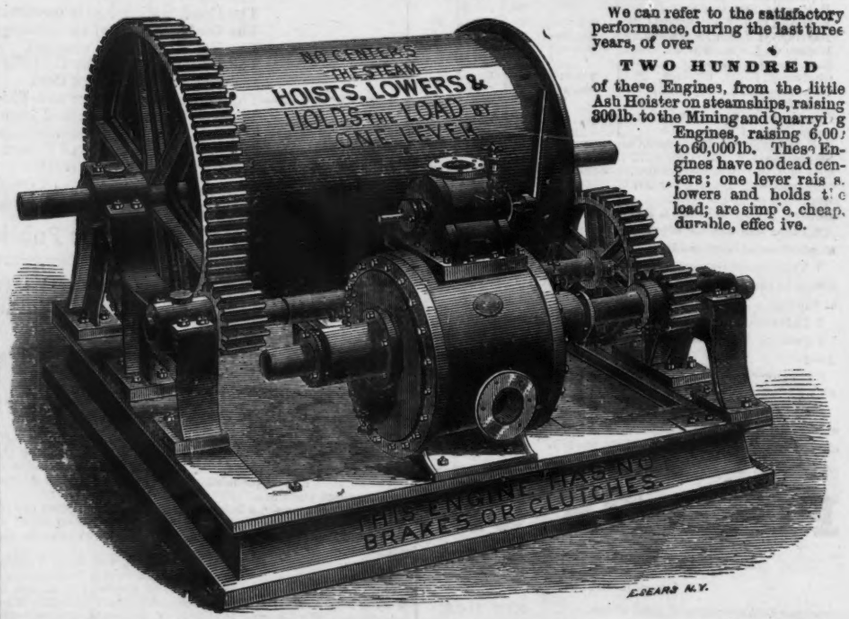

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